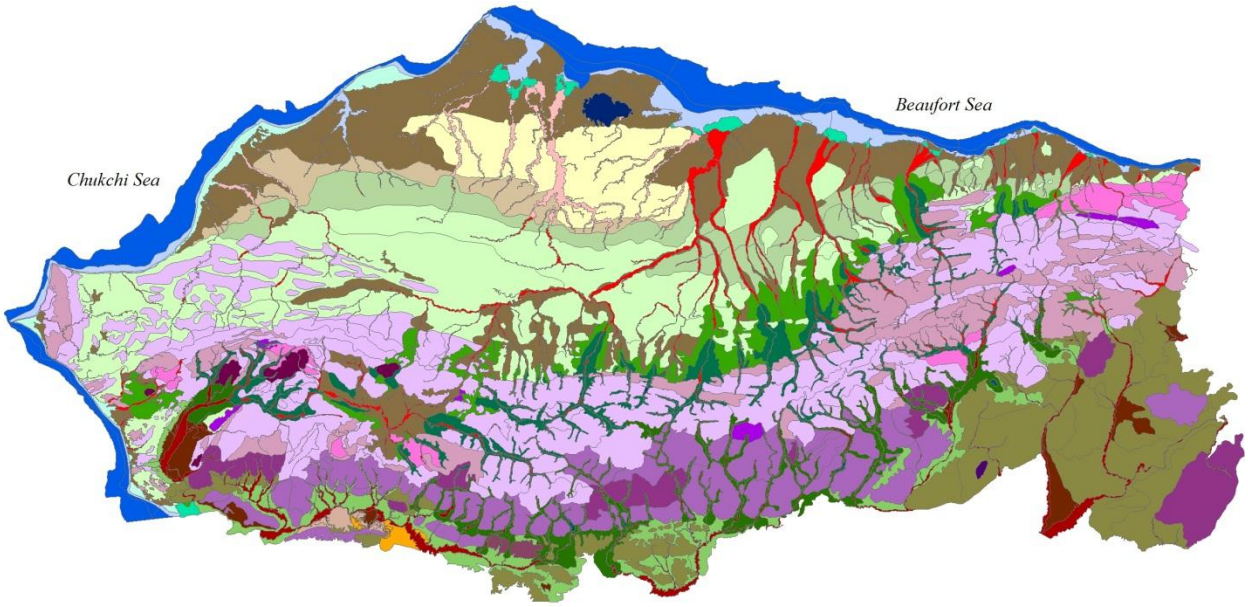
LANDSCAPE-LEVEL ECOLOGICAL MAPPING OF NORTHERN ALASKA AND FIELD SITE PHOTOGRAPHY



Final Report Prepared for:
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26 February 2013

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ACKNOWLEDGEMENTS

We thank Philip Martin and Jennifer Jenkins, FWS, for their technical reviews. Will Fisher, GINA, did the programming for web-based data visualization., Previous portions of subsection mapping that was integrated by this regional map was done by David Swanson (Kobuk, Cape Krusenstern), Keith Boggs (Gates of the Arctic), Michael Heiner, TNC (floodplains), Will Lentz, ABR (Floodplains).

1 INTRODUCTION

An ecological land classification is essential to evaluating land resources and refining management strategies for various areas. More specifically, a landscape-level stratification can be used to more efficiently allocate inventory and monitoring efforts, to improve land cover classifications developed from remote sensing, to partition ecological information for analysis of ecological relationships and develop of predictive models, and to improve recommendations for ecological restoration.

Federal land managers, non-governmental organizations, and industry have been developing ecological land classifications at regional and landscape-level for Alaska to aid in ecosystem management. An ecoregion map that covers the entire state was produced by Nowacki et al. (2002). At the landscape level, ecological subsection mapping has been done for all National Park Service (NPS) and Forest Service lands in Alaska. In northern Alaska, a portion of the North Slope has been mapped at the ecological subsection level by industry (Jorgenson et al. 2003). In the Brooks Range, similar mapping has been done for National Parks and Preserves at Cape Krusenstern (Swanson 2001), Noatak (Jorgenson et al. 2002), and Gates of the Arctic (Boggs 2001), and for the US Fish and Wildlife Service at the Arctic National Wildlife Refuge (Jorgenson 2004).

These maps were integrated into a comprehensive map by the Nature Conservancy (Jorgenson and Heiner 2004). The final product of this effort was a large poster that provided a map with associated legend describing the ecotype units. The spatial registration of the delineations was only sufficient for general regional qualitative evaluations at a scale of 1:1,000,000, and was not appropriate for more detailed analysis and modeling. In addition a large portion of the National Petroleum Reserve Alaska (NPRA) was not completed.

This project was intended to address these deficiencies by: (1) compilation and georectification of existing surficial geology maps of northern Alaska to provide better base information for updating the map delineations; (2) complete ecological mapping within NPRA; (3) improve ecological boundary delineations, unit classification, and reference documentation across the entire North Slope (4) integrate ecological mapping products with available photography in a web based tool for improved interpretation and understanding; and (5) provide results in format appropriate for regional GIS analysis at an approximate scale of 1:300,000 (±150m).

2 BACKGROUND

2.1 Ecological Land Classification

An ecological land classification involves the organization of ecosystem components within a hierarchical framework of spatial and temporal scales (Rowe 1961, Wiken and Ironside 1977, O'Neil et al., 1986, ECOMAP 1993, Klijn and Udo de Haes 1994, Bailey 1996). Smaller-scale features, such as vegetation, are nested within larger-scale components, such as climate, physiography, and geology. Climatic factors, particularly temperature and precipitation, typically account for the majority of global variation in ecosystem structure and function (Walter 1979). Physiography (the distribution of broad-scale landforms with characteristic substrate types, surface shapes, and relief patterns) controls the spatial arrangement and rate of geomorphic

processes because topography affects flows of material and energy (Swanson et al. 1988, Bailey 1996). Geology is important at the landscape scale because bedrock structure and chemistry affect weathering rates, surface morphology, and nutrient availability (Jenny 1941, Bailey 1996). These large-scale "state" factors (climate, physiography, geology), therefore, can be used as differentiating criteria for delineating ecosystems at various scales (ECOMAP, 1993). In our landscape-level mapping, we mapped at the ecological subsection level (more narrowly defined geology with repeating associations of geomorphic units and plant communities), and then attributed these units in the GIS database with their respective ecological sections (physiographic regions with similar geology and regional climate) and ecoregions (physiographic regions with a similar regional climate, Appendix Table 1).

For example, the NPS has used the maps for their inventory and monitoring work. NPS and The Nature Conservancy have used the maps for landcover mapping and modeling. The oil industry has used the maps for environmental impact assessment.

2.2 Field Site Photography

Photography is an important part of plot documentation during landcover mapping field surveys. Ground-level oblique photos generally are taken of sites visted in the field. In addition, opportunistic overflight photos generally are taken from plane or helicopter by field teams during travel between field sites.

Landcover field data are collected at considerable expense and are used extensively during landcover mapping to provide validation of the mapping effort. These photos also can be an important source of information to other analysis because they provide site specific information about landcover and landscape conditions. Providing these photos to a broader user community is limited by the large number of photos, access to appropriate technology for viewing and required storage space. Providing these photos through a web-based mapping interface lowers the barriers to use of these photos by a wide variety of users and promotes a better understanding of ecological conditions throughout the study area.

2.3 Web Visualization

The Geographic Information Network of Alaska (GINA) is the mechanism within the University of Alaska-Fairbanks (UAF) for sharing data and technical capacity among Alaskan, Arctic, and world communities (http://gina.alaska.edu/). Established in 2001, GINA promotes collaboration at the local, state, and federal levels by increasing community-wide participation in the discovery and use of geospatial data.

In developing this project, GINA sought to move the presentation of results beyond a descriptive report/poster presentation and provide GIS and web-based products that would encourage integration of this work with ongoing research. The ecological landscape delineations were produced as shapefiles and are also available through an OGC 1.3.0 compatible WMS. In addition, the database of field site photography was combined with orthoimagery and the ecological landscape delineations through a web mapping visualization interface. This integration of information products through web mapping tools is intended to facilitate use of these products and as well as promote a better understanding of the site ecological condition.

3 METHODS

3.1 Map Data Compilation

Existing information was compiled to aid mapping, including: (1) NASA's GeoCover Landsat orthorectified image mosaics (15m) and GINA's SPOT (Système Pour l'Observation de la Terre) orthorectified image tiles (5m); (2) bedrock geology, surficial geology, and glacial geology maps to help differentiate lithology; (3) subsections from existing mapping; and (4) other regional information that helped in ecological zonation (5) field site photography.

Most geology maps were obtained as scanned images of hard copy maps available from the digital publications compiled by Alaska Geological and Geophysical Surveys, while a few maps were available as GIS vector files (Table 1). The scanned maps were georectified to the GeoCover imagery using ground control points obtained from distinct features evident on both images and using a 2nd order polynomial transformation. RMS errors from the resulting georectifications usually were 30–100 m because of errors associated with the original USGS topographic maps, manual linework of the original geologic mapping, and distortion from scanning.

Most subsections in the database were produced by earlier mapping efforts supported by the NPS, industry, and non-governmental organizations and are documented in earlier reports (Jorgenson 2001, Swanson 2001, Boggs 2001, Jorgenson et al. 2002, Jorgenson et al. 2003, Jorgenson and Heiner 2004). These maps had previously been compiled into an integrated GIS database by Jorgenson and Heiner (2004) and Jorgenson et al. (2009). But the compilation from the earlier efforts was incomplete due to the lack of mapping in the NPRA region and lack of full attribution. Thus, the major effort was focused on the incompletely mapped area (Figure 1).

3.2 Field Site Photography

Field site and overflight photos were compiled from existing North Slope landcover mapping projects conducted by BLM. These landcover mapping projects were conducted in 1994, 1995, 1996, 2008, 2010 and 2011. In addition the USFWS conducted field vegetation sampling efforts on the North Slope during the early 90's. These USFWS data were located on Alaska high altitude photography (AHAP) photos using pin pricks and hardcopy photos of the field sites were printed. As part of this project the AHAP photos were scanned and registered to satellite orthoimagery. USFWS field sites were located then digitized from the georectified AHAP photos. All USFWS site photos were also scanned. A database of for all plot locations and associated scanned photos was compiled.

Table 1. List of surficial and bedrock geology maps compiled for mapping of ecological subsections.

Region or Quad	Source	Map Type	File Name
Surficial Geology Maps			
Arctic NWR coastal plain	Carter et al. 1986	scanned	ANWR coastal plain Engineering geology map Carter 1986 clip.img
Noatak Parklands	Hamilton 2010	vector	Noatak Surficial Geology Hamilton
Beechey Point Quad-A-B	Rawlinson 1993	scanned	Beechey Point Quad-A-B surficial geology Rawlinson 1990 rms5.img
Harrison_Bay	Carter and Galloway 1985	vector	Harrison_Bay_250K
Chandler Lake	Hamilton 1979	scanned	Chandler Lake surficial geol Hamilton 1979 clipped rect.img
Howard Pass	Hamilton 1984	scanned	Howard Pass surficial geology Hamilton 1984 rect30.img
Ikpikpuk	Carter and Galloway 1988	scanned	Ikpikpuk engineering geology map Carter 1988 clippedrect30.img
Killik	Hamilton 1980	scanned	Killik River surficial geology Hamilton 1980 clipped.img
Lookout Ridge	Yeend 1983	scanned	Lookout Ridge surficial geology map Yeend 1983 clipped.img
Umiat	Carter and Galloway 1986	scanned	Umiat Engineering geology map clipped.img
Mikkelsen Bay Flaxman Quads	Rawlinson 1993	scanned	Mikkelsen Bay Flaxman Quads surficial geology Rawlinson 1990 rms7.img
Meade River	Williams 1983	scanned	Meade River Quad engineering geology Williams 1983.img
Philip Smith	Hamilton 1978	scanned	Philip Smith surficial geology Hamilton 1978 rect.img
Teshekpuk	Carter 1983	scanned	Teshekpuk engineering geology map Carter 1983 clipped rect.img
Utukok	Yeend 1984	scanned	Utukok surficial geology map Yeend 1984 clipped rect.img
Wainwright	Williams 1983	scanned	Wainwright surficial geology Williams 1983 rect.img
NPRA	Williams et al. 1977	scanned	NPRA Surficial Geology Map Williams 1977.img
Barrow	Williams and Carter 1984	scanned	Barrow Engineering geology map clipped.img
Alaska	Karlstorm 1964	vector	surficial_geology_AK_akalb27.shp
Bedrock Geology Maps			
ANWR	Imm et al. 1993	scanned	ANWR Geology map clipped Imm 1993 rms96.img
Alaska	Beikman 1980	vector	geology_ak_alb27
Brooks Range	Grybeck et al. 1977	scanned	Brook Range bedrock geology Grybeck 1977 rect-rms166.img
NPRA	Mayfield et al. 1978	scanned	NPRA Southern bedrock geology Mayfield 1978 rms28.img
Northern Alaska	Moore et al. 1994	scanned	Moore geology map northern Alaska clipped.img
Utukok-Corwin	Chapman and Sable 1960	scanned	Utukok-Corwin geology map Chapman 1960 rect-rms474.img

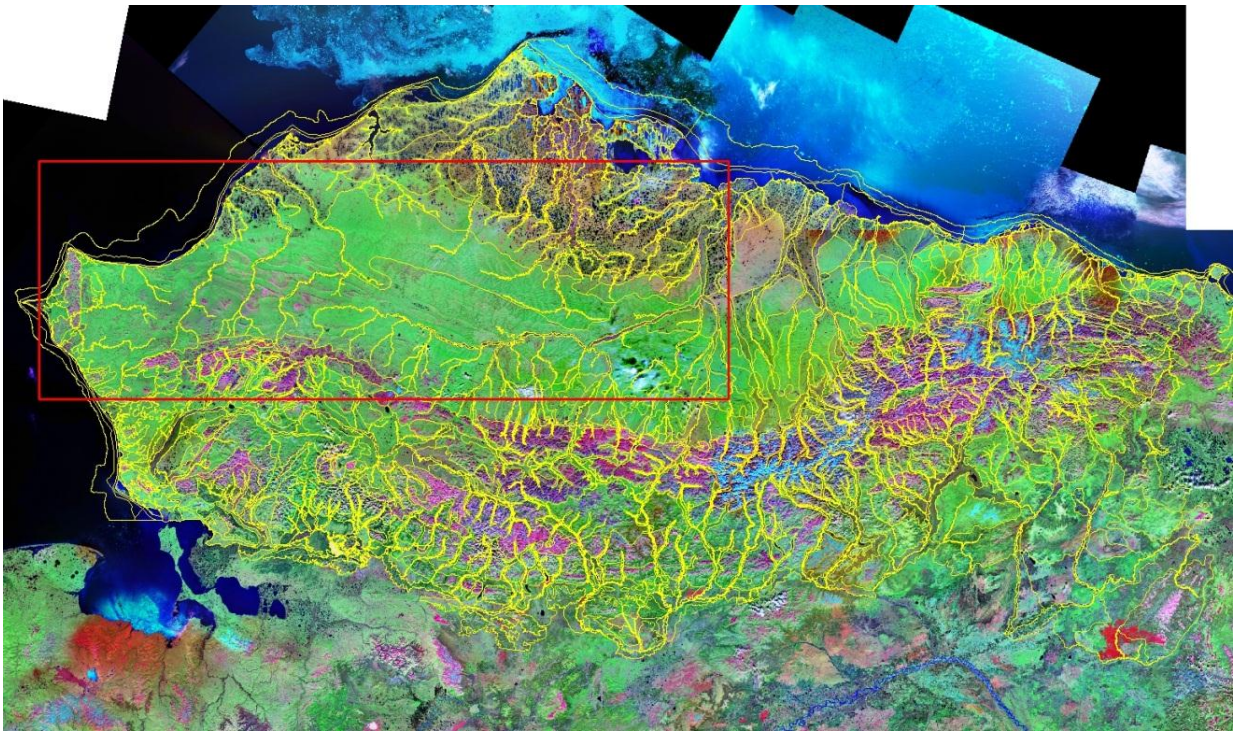

Figure 1. Region (red box) that was the focus of the 2012 update of the subsection mapping.

3.3 Classification and Mapping

Regions with uniform lithology and physiography, with repeating patterns of soil and vegetation, were delineated. Mapping of new subsections and revision of existing subsections was done "on-screen" at ~1:200,000 scale (good for final map production at 1:1,000,000 scale) within a ArcMap geodatabase. Minimum mapping width for floodplains was 150 m. The projection was Albers Alaska NAD83. Each polygon was coded with attributes for ecoregion (ECOREGION), ecological section name (SECTION_), ecological subsection name (SUBSECTION), ecological subsection code (SUBSECT_CO), physiography (PHYSIOGRAP, see Appendix Table 1 for details), generalized geology (GEN_GEOL, see Appendix Table 2 for details), lithology (LITHOLOGY), soil landscape (Soil_Landscape), biome (Biome), mean annual air temperature °C (PRISM_ave_MAAT), average elevation in meters (Elev_ave_NED_m), ecological landscape (Eco_Landscape) and area in square kilometers (Shape_Area). During mapping temporary fields were attributed for date digitized (DATE_DIGIT), dominant bedrock types from source map (Geology_long), dominant water body class from original subsection maps (WATERTYPE; incomplete), origin of subsection mapping (SOURCE), literature reference (Reference), land management agency (Land_Mngr), and climate region (clim_reg), but the attribution was used only to help with map development and were deleted from the final web-distributed version.

An ecological landscape classification was derived from the ecological subsection attributes. First, a soil landscape attribute (e.g., Rocky Upland) was developed by combining the attributes

from the lithology classes (simplified) and the physiography classes. This is similar to the approach and nomenclature for soil landscapes mapped for the Arctic Network of national parks (Jorgenson et al. 2009). Second, an ecological landscape attribute (e.g, Boreal Rocky Uplands) was developed by combining the attributes for biome, lithology, and physiography. The ecological subsection map differs from the ecological landscape map, because each subsection unit is unique and named after a prominent geographic feature, whereas, ecological landscapes group subsections with similar characteristics.

3.4 Web-based Tools

For this project GINA built a web-based mapping visualization tool to display the ecological landscape delineations and the ground and low-level aerial photography that were compiled as part of this project. The web-based tools were designed to display the point locations of the photographs and link the locations to a database of photos associated with those points. Selection of the point with the cursor within the web map tool allowed the display of the appropriate photo and vegetation type name assigned by BLM's Landcover mapping effort associated with that point. GINA currently provides a web service of compiled orthoimagery for Alaska called the "best data layer" (BDL), and the BDL was used as a background layer for the web map tool. Ecological landscape delineations are available as a background layer in this web map tool and are also provided as an OGC compliant WMS. Ecological landscape descriptions and representative photos are linked to the background layer and can be viewed by clicking on ecological landscape units.

GINA uses an open source, linux environment that emphasizes robust security and efficient delivery of services using Ruby on Rails for the server code. An OpenLayers map interface is used for visualization of GIS data/projects and satellite imagery is provided through GINA/SDMI WebTile services. GINA web services are run on multiple linux servers using CentOS 5.3, with Apache, Postgres/PostGIS, and Passenger services.

4 RESULTS AND DISCUSSION

4.1 Ecological Mapping:

Numerous imagery and mapping products were compiled for use in the map revision. Six Landsat GeoCover image mosaics were compiled that provided comprehensive coverage at 15-m pixel size. Approximately 280 tiles of georectified SPOT images produced by GINA were compiled that covered about one-half of the study area at 5-m pixel size. Geologic maps included 19 surficial geology maps and 5 bedrock geology maps. The larger scale 1:250,000 scale surficial geology maps covered about three-quarters of the study area (Figure 2). Georectification was done for 16 surficial geology maps and for four bedrock geology maps. The subsection mapping used existing subsection mapping that had previously been compiled by Jorgenson and Heiner (2004) and Jorgenson et al. (2009) and covered about 90% of the study area.

The 2012 revisions to the 2006 ecological landscape map resulted in 533 ecological subsections based on mapping of 1713 polygons (Appendix Table 5). Revisions to the map were most extensive in the southern NPRA region and within the Brooks Foothills ecoregion (Figure 3).

The entire map covers 413089 km^2, of which 391951 km^2 covers the land portion, excluding the Beaufort and Chukchi seas.

The 533 ecological subsections (Figure 4) were nested within 55 ecological sections (Table 2, Figure 5) and 14 ecoregions (Figure 6). Attribution of the ecological subsections allowed development of thematic maps of physiography with 11 classes (Figure 7, Appendix Table 2), generalized geology with 25 classes (Figure 8, Appendix Table 3), and ecological landscapes with 31 classes (Figure 9). Representative photographs of the ecological landscapes are provided in Figures 10–13 and described in Appendix Table 4.

4.2 Site Photography and Web-based Tools

Approximately 14,400 photographs were compiled from individual field projects. Point locations for all photos were developed from available data and a directory structure and database format was established to link photo image files with the associated point locations. Image formats were converted to .jpg for all photos to facilitate web display.

The site photographs can be displayed over orthoimagery (BDL) or the ecological landscape layer in a web based mapping tool (http://ecological-landscapes.hub.gina.alaska.edu/). Photographs from the various years can be turned on and off, and individual points can be clicked to display photographs at that site (Figure 14). The ecological landscapes map can be viewed and a description of mapping classes is provided on clicking any unit of the map.

5 SUMMARY AND CONCLUSION

To aid in assessment of ecological, landscape, and climate change in northern Alaska, the previous 2006 ecological landscape map for northern Alaska was updated in 2012 with support from the Arctic Landscape Conservation Cooperative. The 2012 revisions focused on completing the incompletely mapped portion of the southern NPRA, improving mapping of glacial and outwash deposits within the Brooks Foothills, and improving consistency with existing surficial and bedrock geology maps in northern Alaska. The revisions resulted in 533 ecological subsections, nested within 55 ecosections and 14 ecoregions covering 413,089 km^2. Attributes for the map polygons in an ArcMap geodatabase include information on physiography, generalized geology, lithology, soil landscapes, ecological landscapes, elevation, and climate. The attributes allow production of derived map products such as physiography, generalized geology, and ecological landscapes. The 2012 version of the map can be updated as new information is compiled and revisions are needed. The map will form the basis for a new permafrost mapping project and will be updated as permafrost data is incorporated.

Products from this mapping analysis were integrated within a web-base map visualization tool with orthoimagery and approximately 14,400 field site photographs. The photos provide site specific information regarding landcover and condition which can assist in a better understanding of the more general ecological landscape delineations.

Further details regarding access to project products including GIS files can be found at the project website: (http://gina.alaska.edu/projects/ecological-mapping-and-field-data).

Table 2. Number of mapped polygons by ecological section and ecoregion for northern Alaska.

Row Labels	Beaufort Sea	Chukchi Sea	Beaufort Sea Coast	Northern Chukchi Coast	Southern Chukchi Coast	Beaufort Coastal Plain	Kotzebue Sound Lowland	Yukon-Old Crow Basin	Kobuk Ridges and Valley	Brooks Foothills	Northern Brooks Range	North Ogilvie Mountains	Southern Brooks Range	Davidson Mountains	Grand Total
Central Beaufort Offshore Water	2														2
Eastern Beaufort Offshore Water	2														2
Western Beaufort Offshore Water	2														2
Northern Chukchi Offshore Water		2													2
Southern Chukchi Offshore Water		2													2
Kotzebue Sound Nearshore Water		2													2
Colville Coast			5												5
Icy Coast			5												5
Ikpikpuk Coast			13												13
Leffingwell Coast			13												13
Stefansson Coast			9												9
Wainwright Coast				8											8
Kotzebue Coast					2										2
Krusenstern Coast					9										9
Central Beaufort Coastal Plain						35									35
Eastern Beaufort Coastal Plain						59									59
Western Beaufort Coastal Plain						90									90
Kotzebue Coastal Plain							3								3
Old Crow Flats								5							5
Porcupine Lowland								8							8
Rampart Lowland								2							2
Kiana Hills									22				5		27
Kobuk Uplands									115						115
Koyukuk Uplands									38						38
Noatak Lowland									25						25
Upper Eastern Brooks Foothills										45					45
Upper Central Brooks Foothills										220					220
Krustenstern Coastal Plain										12					12
Lisburne Mountains										12					12
Lower Central Brooks Foothills										60					60
Lower Eastern Brook Foothills										19					19
Lower Western Brooks Foothills										26					26
Upper Western Brooks Foothills										88					88
Wulik Foothills										50					50
Endicott Northern Mountains											61				61
DeLong Mountains											70				70
Noatak Basin											42				42
Philip Smith Northern Mountains											25				25
Noatak Mountains											22				22
Baird Northern Mountains											18				18
British Mountains											46				46
Franklin Mountains											21				21
Romanzof Mountains											53				53
Sadlerochit Mountains											11				11
North Ogilve Mountains												4			4
Philip Smith Southern Mountains													16		16
Endicott Southern Mountains													61		61
Junjik Mountains													52		52
Chandalar Mountains													47		47
Schwatka Mountains													11		11
Baird Southern Mountains											1		7		8
Kobuk Mountains													56		56
Sheenjek Hills														15	15
Sheenjek Mountains														54	54
Old Crow Mountains														5	5
Grand Total	6	6	45	8	11	184	3	15	200	532	370	4	255	74	1713

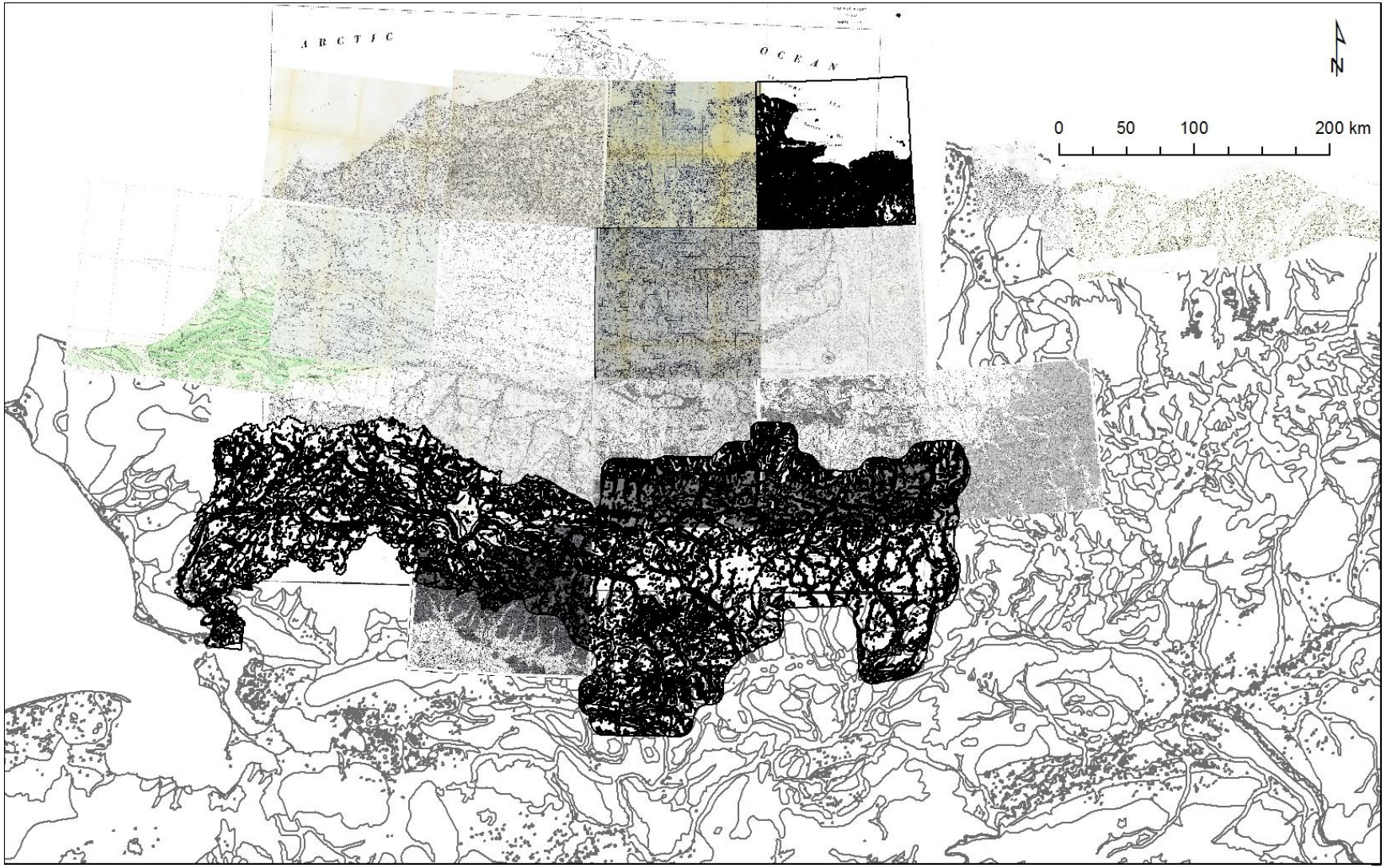

Figure 2. Compilation and georectification of surficial geology maps that have been produced for northern Alaska. Line lines represent areas were data are available in vector format. Smaller scale surficial geology map by Karlstrom (1964) provided in background.

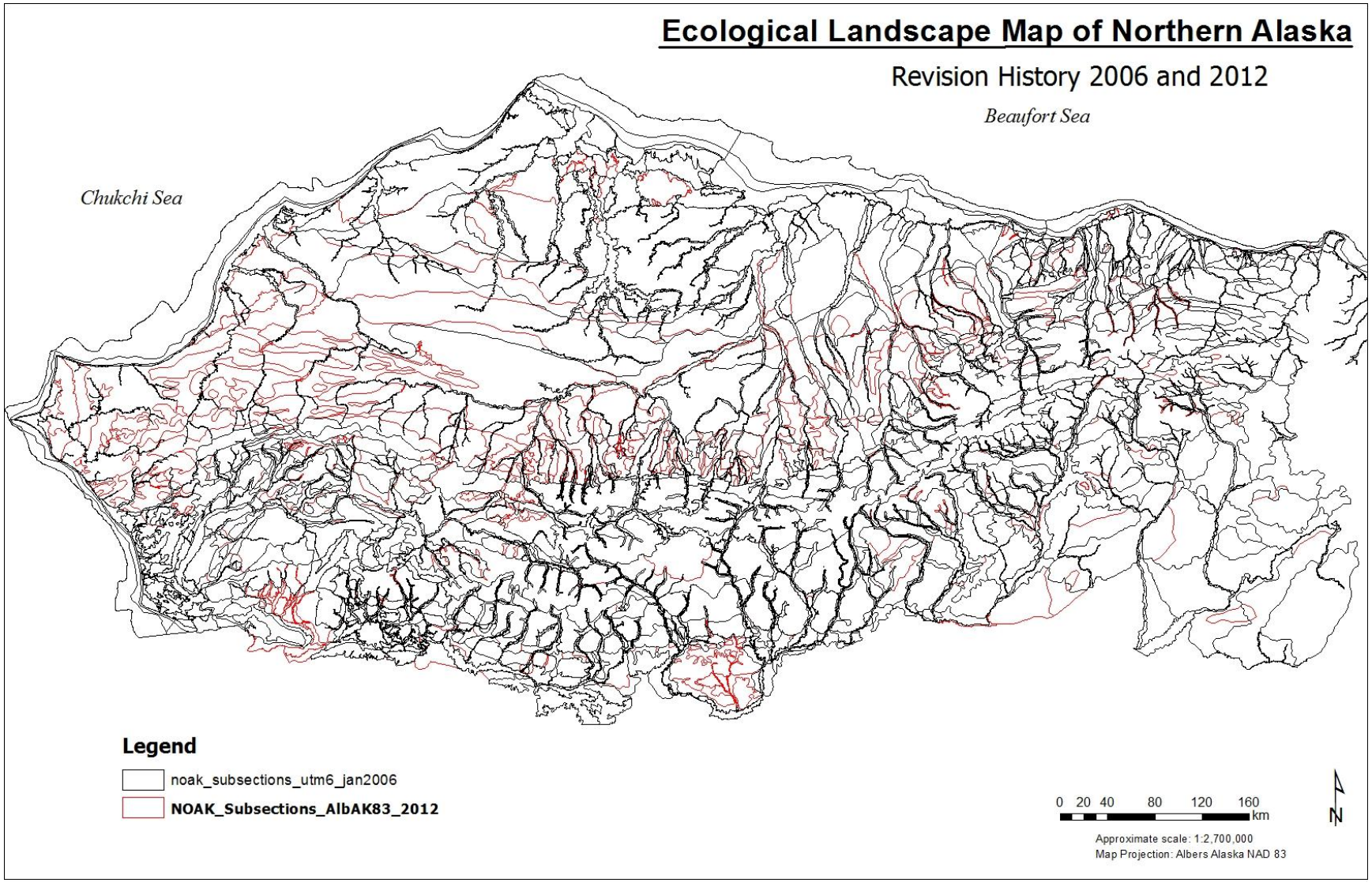

Figure 3. Comparison of 2012 (red) and 2006 versions of the ecological map showing the extent of revisions.

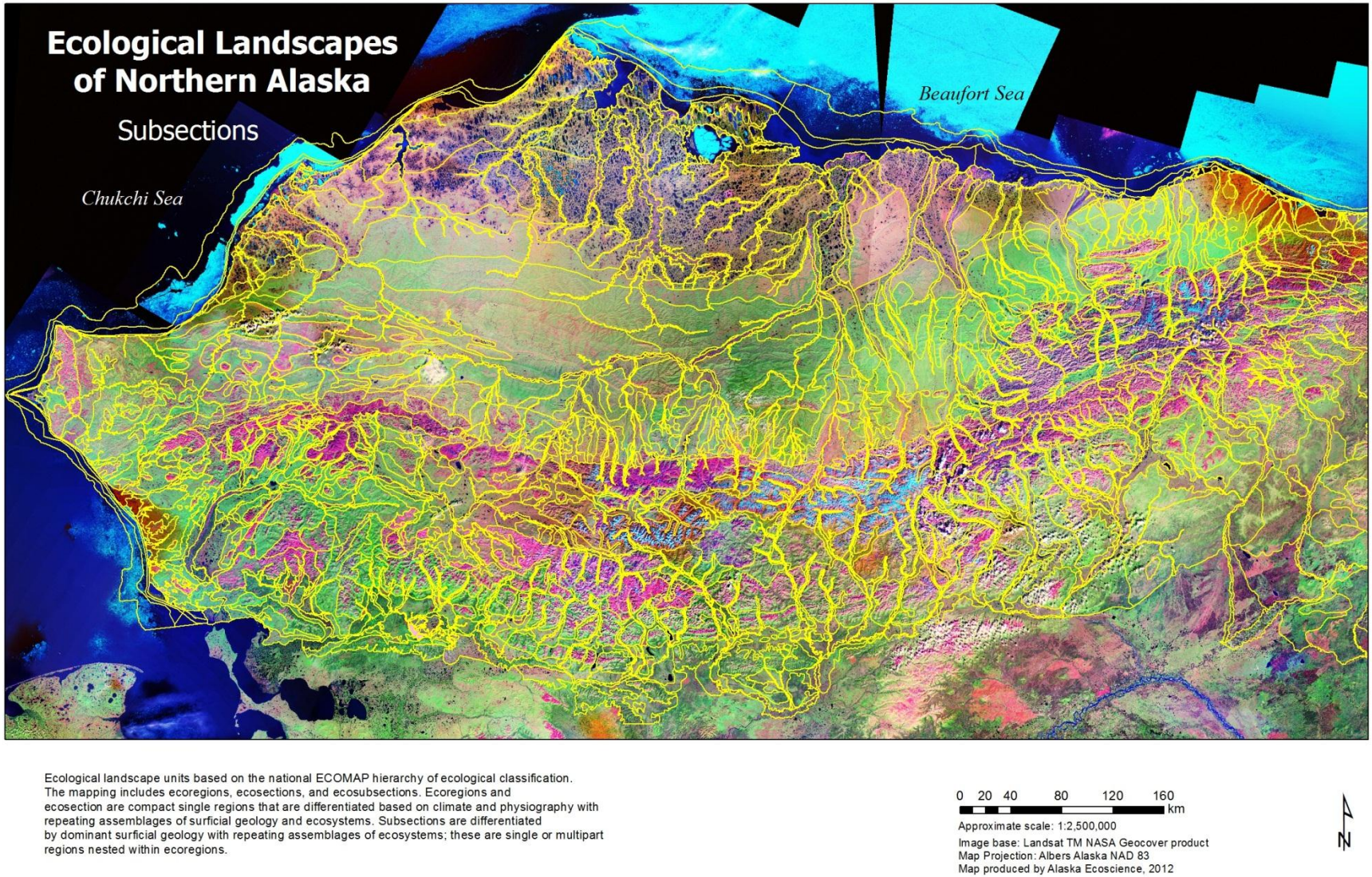

Figure 4. Ecological subsections map for northern Alaska. Individual subsections are not labeled.

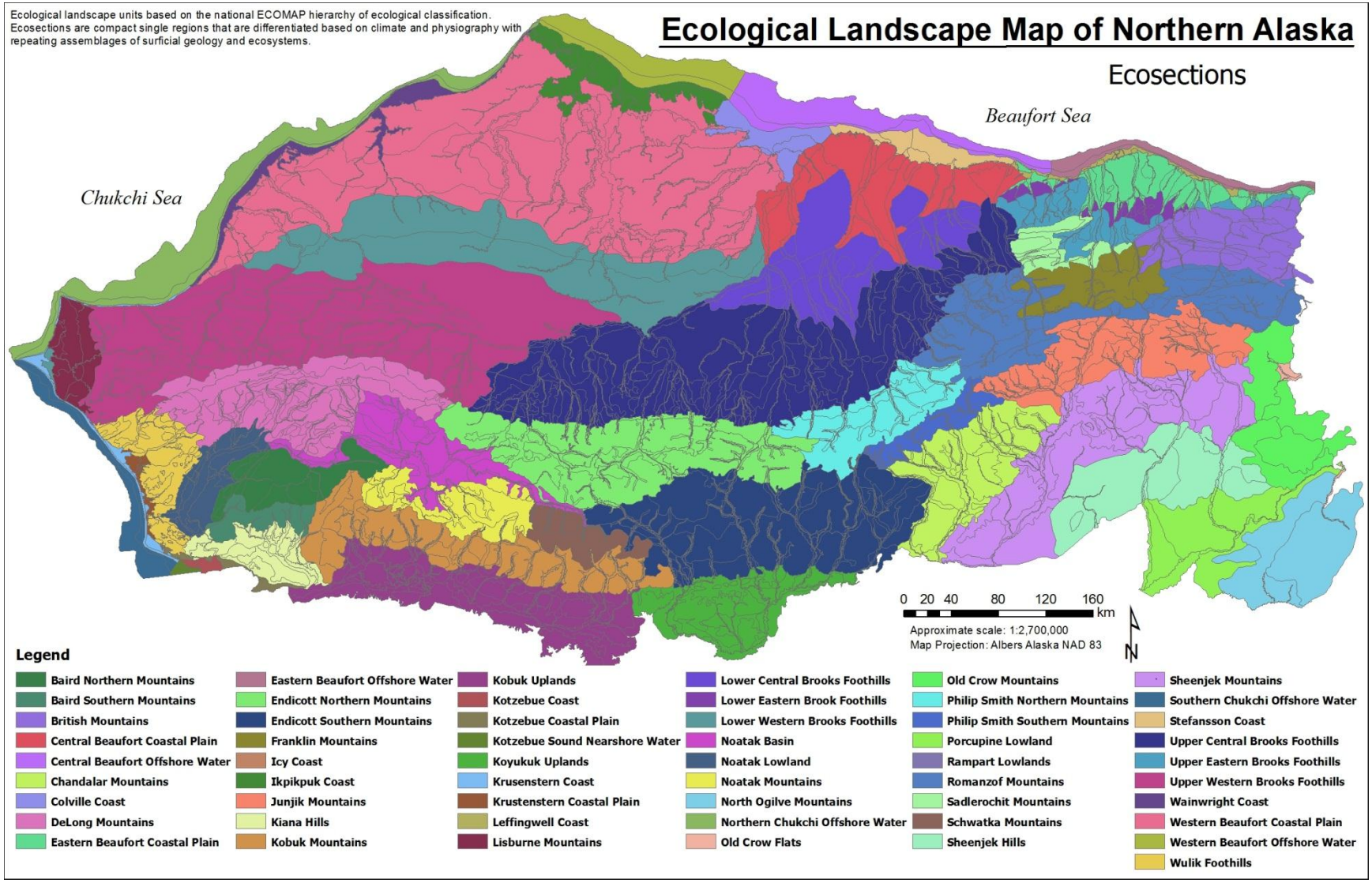

Figure 5. Ecological sections of northern Alaska based on the aggregation of subsections.

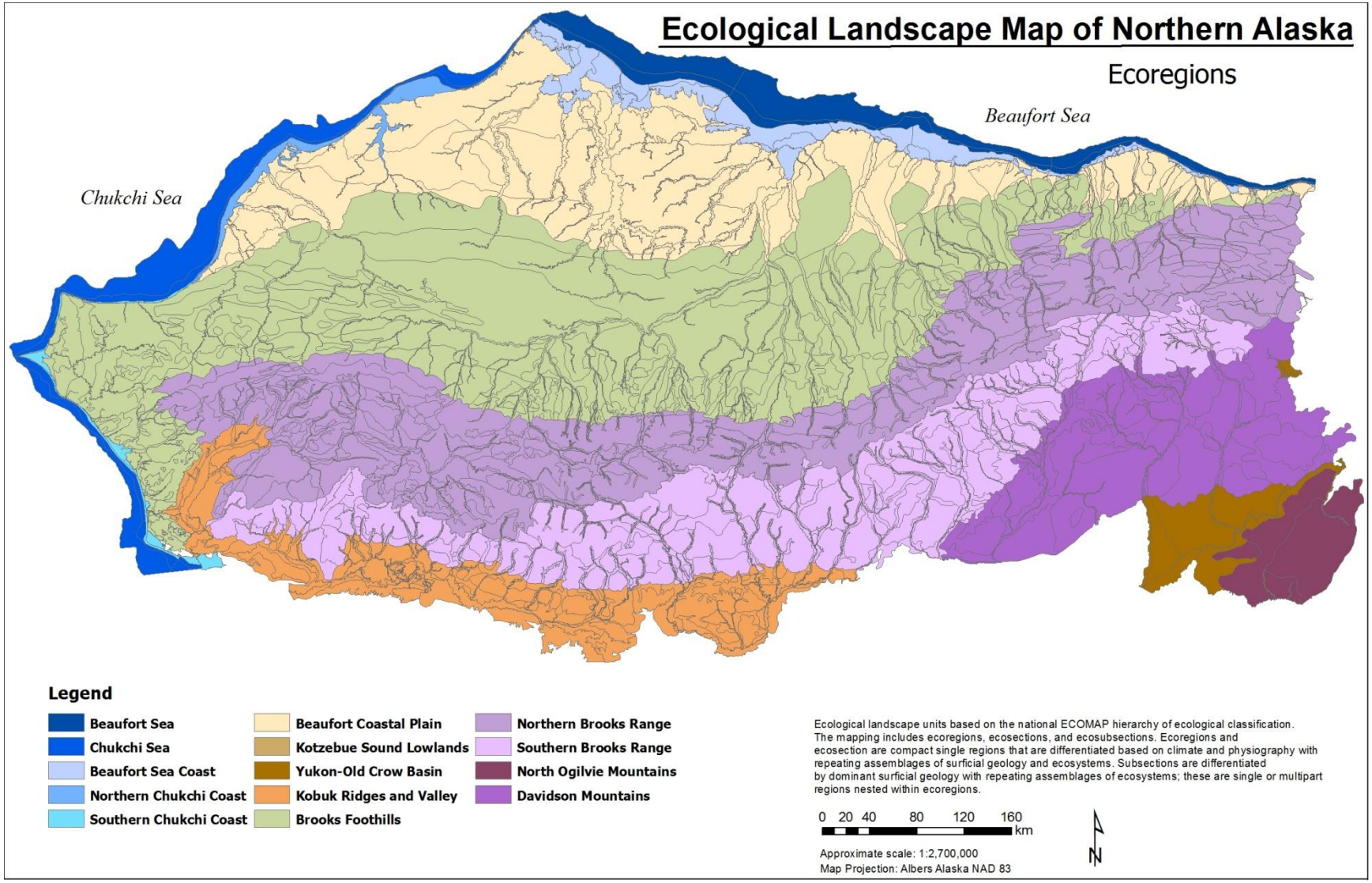

Figure 6. Ecoregions of northern Alaska based on the aggregation of subsections. Ecoregions differ from those of Nowacki et al. (2002) by the addition of coastal ecoregions, division of the Brooks Range into northern and southern ecoregions, and finer resolution boundaries.

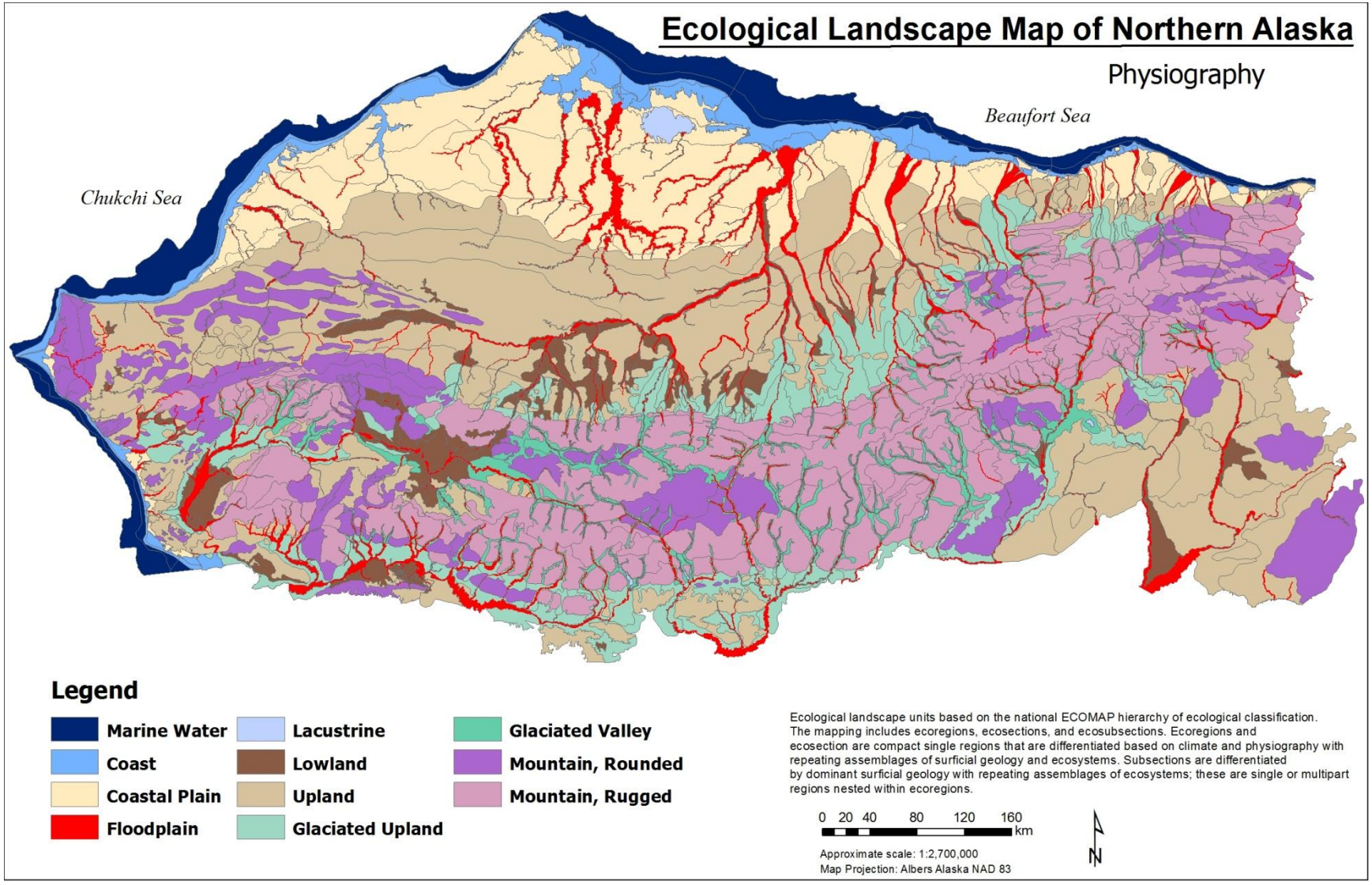

Figure 7. Physiography of northern Alaska derived from the ecological subsections map.

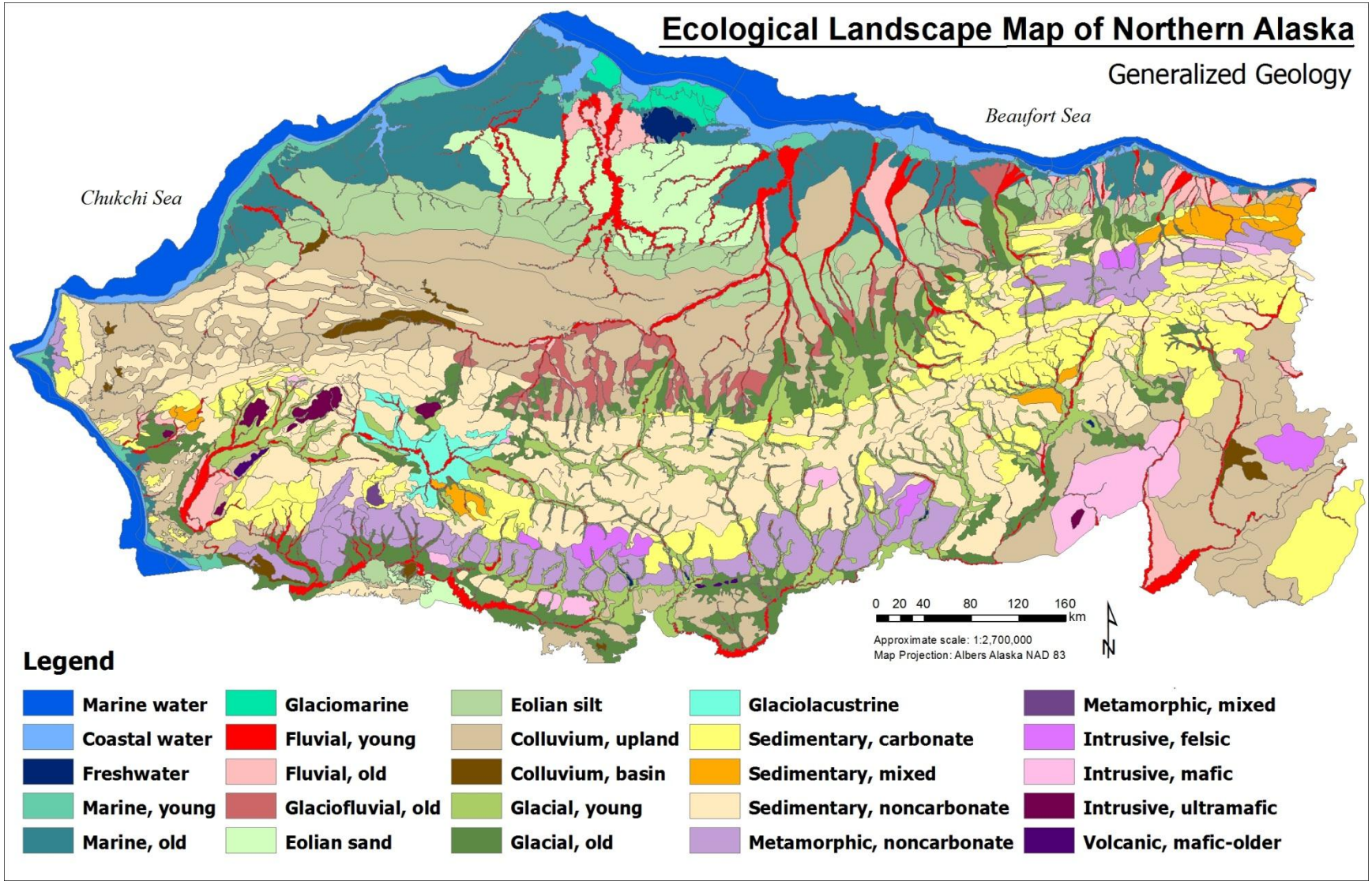

Figure 8. Generalized geology of northern Alaska derived from the ecological subsections map.

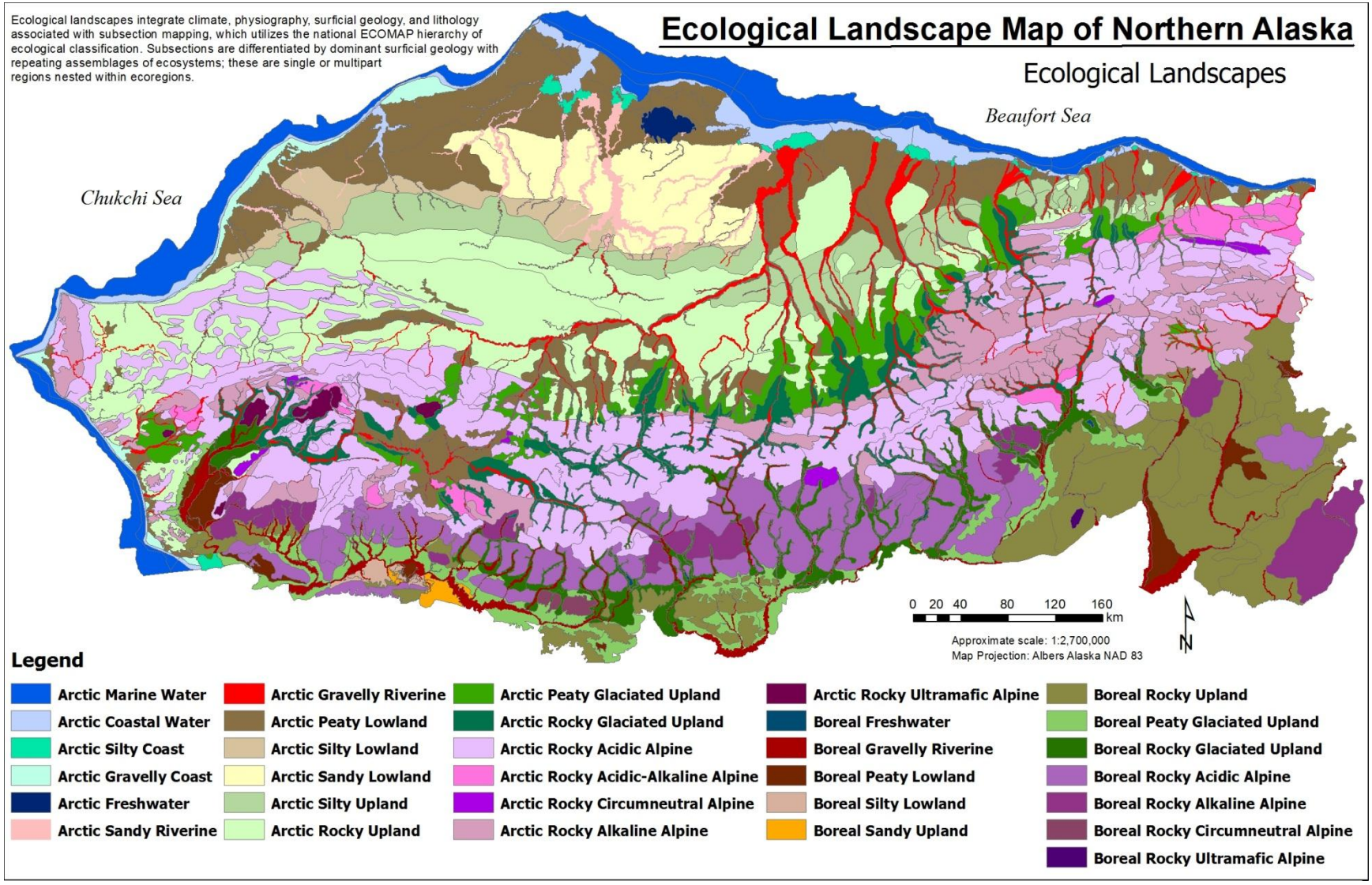

Figure 9. Ecological landscapes of northern Alaska derived from the ecological subsections map.

Figure 10. Obique aerial photographs of arctic coastal, riverine and lowland landscapes.

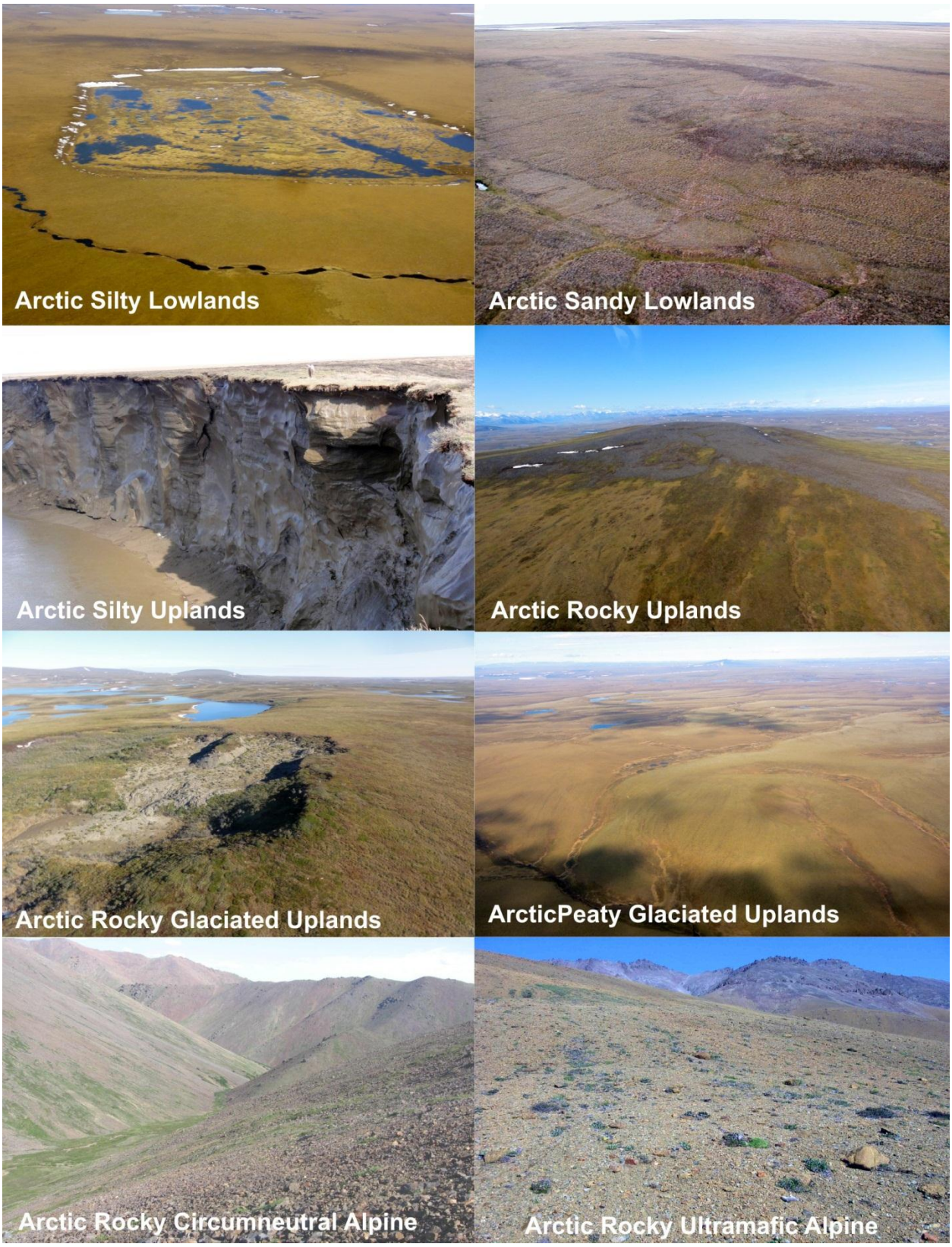

Figure 11. Obique aerial photographs of arctic lowland, upland, glaciated, and alpine landscapes.

Figure 12. Obique aerial photographs of boreal riverine, lowland, upland, and glaciated landscapes.

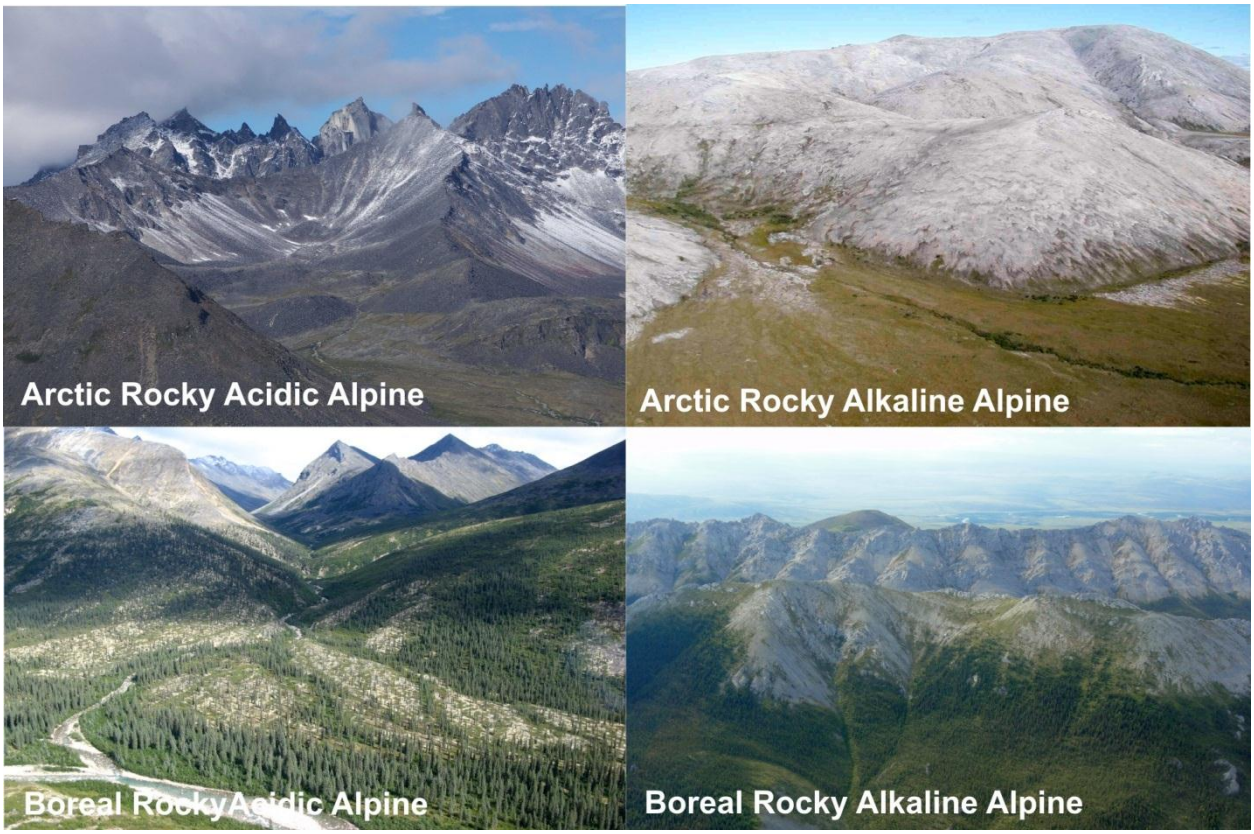

Figure 13. Obique aerial photographs of boreal riverine, lowland, upland, and glaciated landscapes.

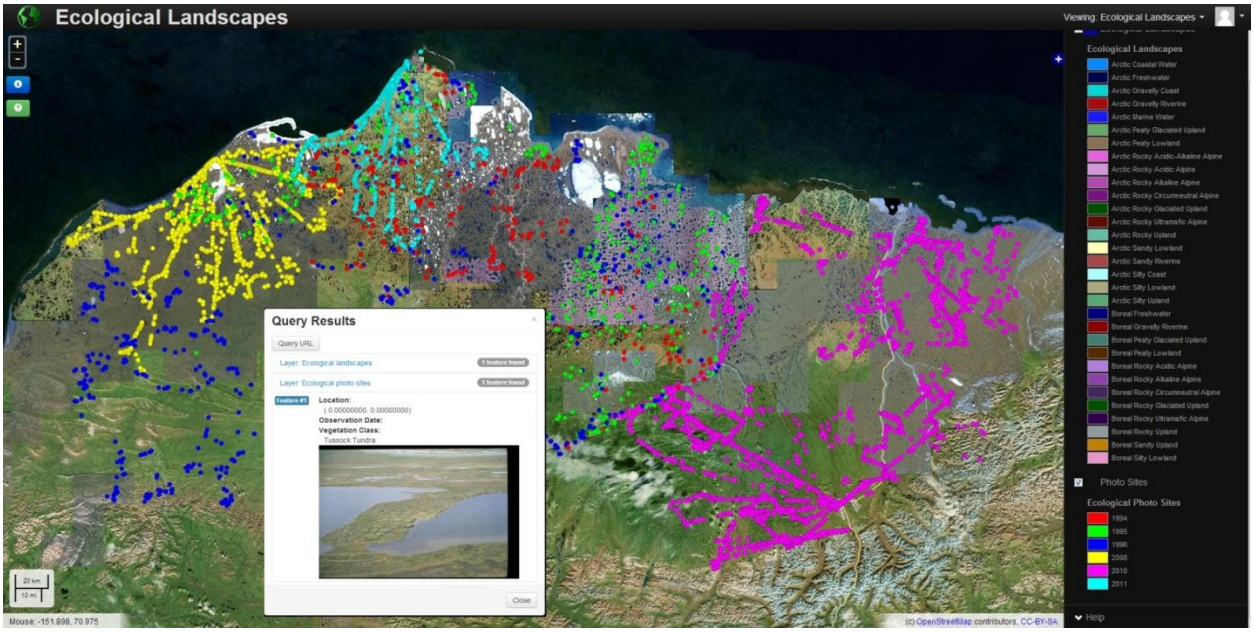

Figure 14: Web-based tool for viewing site photographs.

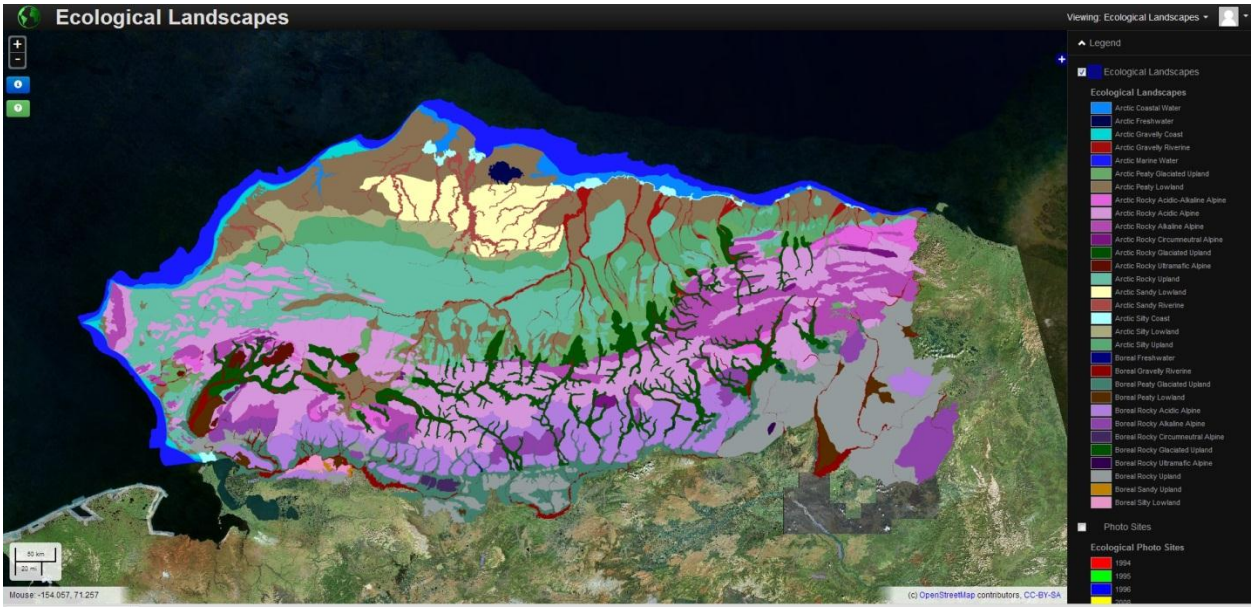

Figure 15: Web-based tool for viewing and querying ecological landscape map.

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7 APPENDICES

Appendix Table 1. Differentiation of ecosystems at various scales.

Ecological Units					Scale		
Bailey (1997), Forman (1997)	Delcourt and Delcourt (1988)	ECO-MAP (1993)	Canadian (Wiken 1981)	Klijn and Udo de Haes (1994)	Typical Map Scale	Typical Areal Extent	Differentiating Characteristics used in this study
Region (Forman)	Cont-inent	Domain		Ecozone	1: 20,000,000	10^{12} m^2 1,000,000 km^2	Continents with related climate
Or Eco-region		Division		Eco-province	1: 10,000,000	10^{11} m^2 100,000 km^2	Climatic subzones with broad vegetation regions.
(Bailey) (macro-scale)	Macro-region	Province	Ecoregion	Ecoregion	1: 5,000,000	10^{10} m^2 10,000 km^2	Climate, a geographic group of landscape mosaics (e.g., Interior Highlands).
Land-scape (Forman) or Land-scape	Meso-region	Section	Ecodistrict	Ecodistrict	1: 1,000,000	10^{9} m^2 1,000 km^2 100,000 ha	Major landforms or physiographic units within a climatic region (e.g. Tanana flats, Steese-White Mountains).
Mosaic (Bailey) (meso-scale	Micro-region	Sub-section		(Eco-subdistricts by ABR)	1:250,000	10^{8} m^2 100 km^2 10,000 ha	Physiographic units at larger scale based on associations of geomorphic units (e.g., grouping of weathered bedrock on crests, residual soil on upper slopes, retransported lowland deposits at toe of slopes, and headwater streams in drainages).
		Landtype Assoc-iation	Ecosection	Ecosection	1:100,000	10^{7} m^2 10 km^2 100 ha	Geomorphic units with homogeneous lithology, mode of deposition, depth, texture, and water properties. Similar concepts include soil catena, toposequence, and soil assocation. (e.g., bedrock or floodplain cover deposit).
Local Eco-system (Forman) or Site (Bailey) (micro-scale)	Macro-site	Landtype	Ecosite	Ecoseries	1: 25,000-50,000	10^{4}-10^{6} 1 km^2 10 - 100 ha	A subdivision of a geomorphic unit that has a uniform topoclimate based on elevation, aspect, slope position, and soil drainage. Similar concepts include soil series, homogeneous abiotic site conditions, climax vegetation, assemblages of vegetation types on soil series (e.g., Ester soil series on north slopes of bedrock soils).
	Meso-site	Landtype Phase	Ecoelement	Ecotype (Ecotope)	1: 5,000 -25,000	10^{2}-10^{4} 0.1-10 ha	Vegetation type or successional stage (e.g., Balsam poplar on floodplain cover deposit).
	Micro-site	Site		Ecoelement	1: 1000 - 5,000	10^{-2} - 10^{2} <0.1 ha	Uniform microsites within stand (e.g., polygon rim vs center).

Appendix Table 2. Definition of physiography classes.

Class	Characteristics
Marine Water	Saline (>30 ppt) nearshore and offshore water that is associated with open oceans overlying the continental shelf. Water typically is greater than 5 m deep and receives little or no dilution, except near river deltas and estuaries.
Coastal	Terrestrial and shallow open water near the coast that are affected by tides, storm surges, and salinization. Coastal geomorphology includes barrier islands, lagoons, rocky shores, deltas, tidal flats, and coastal dunes. Similar to estuarine wetland system of Cowardin et al. 1979.
Coastal Plain	Low-lying, flat to gently undulating plains near the coast that have been affected by past marine erosion and deposition. They have flat to gentle regional slopes, but also may rise to 50 to 150 m in elevation due to past sea levels and tectonic uplift. Deposits can be of both alluvial and marine origin.
Floodplain (Riverine)	Floodplains, or riverine areas, are affected by frequent (within 5 yr) to infrequent flooding (every 5 to 25 years) and sediment deposition. Floodplains are comprised of both gravely to sandy lateral and silty vertical accretion deposits. Deposits include meander channel, meander overbank, braided channel, and braided overbank deposits. Sedimentation and groundwater movement contribute to high productivity. Does not include abandoned floodplains that are rarely flooded and or receive sediments.
Lacustrine	Flat margins of lakes or drained-lake basins that have been affected by lake water fluctuations and deposition of sediments in a lacustrine environment. Lake sediments are generally well stratified and include beaches, bars, deltas, and fans. Lacustrine environments generally are highly productive due to water movement and sedimentation. In permafrost regions,basins where substantial ground ice has developed are considered lowlands.
Lowland	Flat, to gently sloping, low-lying areas that generally are associated with water-gathering and sediment-accumulating environments. Geomorphology includes retransported deposits on lower slopes, abandoned floodplains, outwash, lowland loess, gently undulating sand sheets, and peatlands. Slopes usually are <8 °. Fine-grained deposits tend to have wetlands and permafrost in boreal regions, while gravelly deposits tend to be well-drained and lack permafrost. Differentiating lowlands from uplands can be problematic.
Upland	Hills and middle slopes of mountain valleys that have water-shedding and erosional surfaces. Middle to upper slopes typically are well drained, but in boreal regions north-facing uplands frequently have permafrost. Geomorphology includes weathered bedrock, residual soil, hillside colluvium, talus, upland loess, sand dunes.
Glaciated Upland	Upland areas that are underlain by glacial deposits with kame and kettle topography. Glaciated areas have a mixture of rolling hills, closed basins, and lakes. Geomorphology includes young and old moraines, till sheets, drumlins, The complex topography leads to a wide diversity of ecosystems.
Glaciated Valley	Upland areas within mountainous regions that underlain by glacial deposits. Because of glaciation the valleys are U-shaped and typically have coarse-well drained surface deposits.
Subalpine	Mountain slopes and high plateaus near treeline. Vegetation is dominated by forested woodlands, tall shrubs, and low shrubs. This class is not used in Arctic environments.
Alpine	Mountain slopes above treeline. Vegetation is dominated by herbaceous, dwarf shrub, moss, and lichen growth forms. In boreal regions, the lower elevation of this class varies from 700 to 1000 m. In Arctic regions the lower elevation is problematic.

Appendix Table 3. Definition of generalized geology classes used for ecological mapping.

Class	Description
Colluvium, (Cu)	Gravity-transported sediments related to slope movement on middle to upper slopes, including hillside colluvium, retransported deposits (some slope wash), and solifluction.
Colluvium, basin (Cb)	Gravity-transported sediments related to slope movement on lower slopes and basins. Fine-grained and organic-rich deposits formed from a varied of processes, including solifluction, creep, slopewash, and eolian deposition. This also includes retransported deposits that have a substantial fluvial component.
Fluvial, young (Fy)	Fluvially deposited sediments on active to inactive, braided to meandering floodplains formed during the mid-late Holocene. Includes both gravelly and sandy channel and fine-grained overbank deposits. Soils are affected by frequent to infrequent flooding and sedimentation. Primarily differentiates active and inactive floodplains with early to mid-late successional vegetation.
Fluvial, old (Fo)	Fluvially deposited sediments associated with terraces and abandoned floodplains that are no longer affected by the current fluvial regime. Typically has thick fine-grained overbank deposits over gravelly and sandy channel deposits. Retransported deposits are grouped with basin colluvium
Glaciers and Snowfields (Gg)	Areas with ice, firn, and semi-permanent snow. Glaciers have definite lateral limits and motion in a specific direction. Snowfields are covered with snow year-round and show no movement.
Glacial, young (Gy)	Sediments deposited either in direct contact with glacial ice or deposited by meltwater. Comprised Holocene to Late Pleistocene (Wisconsin) moraines or till with more pronounced topography and poorly integrated drainage network. The glacial terrain has highly heterogenous slopes, soils, and hydrolography, often with kettle lakes.
Glacial, old (Go)	Sediments deposited either in direct contact with glacial ice or deposited by meltwater. Comprised of Holocene to Late Pleistocene (Wisconsin) moraines with subdued topography, advanced basin filling, and well-integrated drainage network.
Glaciofluvial, young (GFy)	Sediments that have been transported and deposited by meltwater streams which flow within or beyond the terminal margin of an ice sheet or glacier, and includes outwash, kames, and eskers. Sediments are well-stratified sand and gravel with some boulders. Young deposits occur in front of an active glacier.
Glaciofluvial, old (GFo)	Sediments that have been transported and deposited by meltwater streams which flow within or beyond the terminal margin of an ice sheet or glacier. Sediments are well-stratified sand and gravel with some boulders. Old deposits are associated with an earlier glacial activity.
Glaciomarine (MG)	Sediments deposited in a wide variety of environments associated with shallow marine or estuarine waters, including grounding-line fans, morainal banks, wedges beneath ice shelves, deltas, and distal environments related to ice-rafting. Sediments tend to be fine-grained, with some sand and occasional boulders.
Eolian silt (El)	Wind-deposited sediments comprised of homogeneous, non-stratified, non-indurated silt and very fine sand, with minor amounts of clay. Pleistocene-aged deposits in permafrost areas can be extremely ice-rich and are termed "yedoma".
Eolian sand (Es)	Wind-deposited sediments comprised of very fine to fine sand. Stratification and cross-bedding is commonly present. Eolian sand can form a variety of dune landforms or sand sheets. Soils are generally ice poor.
Lacustrine	Fine-grained mineral and organic sediments deposited in both glacial and non-glacial lakes. Sediments are generally well stratified with very thin laminations, but coarser deposits, such as beaches, bars, deltas, and fans can also be present.
Marine (M)	Sediments deposited within oceans and estuaries and are high in halites (NaCl). Sediments can vary widely in particle size. Deposits include beaches, bars, spits, lagoon bottoms, and tidal flats.
Organic (O)	Thick (>40 cm) deposits of peat, muck, and interbedded fine-grained mineral material in low-lying areas. Organic deposits can be differentiated into ombrotrophic bogs and groundwater fed fens.
Sedimentary, carbonate (Sc)	Sedimentary rocks dominated by carbonate materials, primarily calcite ($CaCO_3$) and magnesite ($Mg\ CO_3$). Rocks include limestone (Ca-rich), dolostone (Ca, Mg-rich), and calcareous sandstone. Soils formed from these rocks generally are alkaline and rich in humus. Phosphorus availability is reduced by fixation in various calcium phosphate compounds (hydroxyapatite, flouroapatite). In addition, at pH values above 7, excess calcium may hinder phosphorus absorption and utilization of plants.
Sedimentary, noncarbonate	Sedimentary rocks other than limestone, including conglomerate (pebble-cobble rich), sandstone (sand-rich), graywacke, shale (clay-rich), argillite (clay minerals) and chert (SiO_2). Generally low Ca and Na and

Class	Description
(Sn)	high Al concentrations lead to acid soils. High soluble aluminum concentrations can lead to plant growth problems (root growth stopped at Al as low as 1 mg/L). Phosphorus is fixed in large amounts as aluminum and iron phosphates in acid soils.
Sedimentary, mixed (Sm)	Sedimentary assemblage of both carbonate and noncarbonate rocks.
Volcanic-felsic-younger (Vfy)	Felsic extrusive igneous rocks that have light-colored mineral assemblages rich in silica content, such a quartz (SiO_2, highly resistant to weathering), orthoclase feldspar ($KalSi_3O_8$), and muscovite mica (sheet silicates, $Kal_3Si3O10$). Rocks include rhyolite, felsite, rhyocacite, trachyte, and quartz trachyte. Soils are absent to very thin and acidic.
Volcanic-felsic-older (Vfo)	Similar to above, except rocks formed during Tertiary or older periods and are more highly weathered. Weathering forms acidic soils.
Volcanic-intermediate-younger (Viy)	Intermediate extrusive igneous rocks have dark-colored mineral assemblages with minor silica content and high metallic bases, such as amphiboles (Ca, Na, Mg, Fe rich silicates), biotite mica (sheet silicate rich in Fe and Mg), plagioclase feldspar ($NaAlSi_3O_8$, $CaAl_2Si_2O_8$), and minor potassium feldspar (K). Intermediate rocks include quartz latite and latite
Volcanic-intermediate-older (Vio)	Similar to above, except rocks formed during Tertiary or older periods and are more highly weathered. Weathering forms circumneutral soils.
Volcanic-mafic-younger (Vmy)	Mafic and intermediate extrusive igneous rocks have dark-colored mineral assemblages with low silica content and high metallic bases, such as plagioclase feldspar, pyroxenes and olivine (high in Fe, Mg, Ca orthosilicates). The iron- and magnesium-rich minerals are more easily weathered than granites. Mafic rock types include basalt, andesite. and dacite. Soils on the Quaternary age rocks, are absent or thin.
Volcanic-mafic-older (Vmo)	Similar to above except rocks were formed during the Tertiary or older periods and, therefore, are more highly weathered.
Volcanic-pyroclastics-Vp	Detrital volcanic materials that have been explosively or aerially expelled from a volcanic vent Deposits include pyroclastic flows, volcanic breccia, tuffs, ash, ash-flow, and all other tephras.
Intrusive-felsic (If)[1]	Felsic and meta- plutonic rocks that have mineral assemblages dominated by light-colored minerals such as quartz, potassium feldspar, and muscovite. Acidic rocks include granite pegmatite (coarse crystals), granite (fine crystals), granite porphyry (few visible crystals), rhyolite porphyry, and rhyolite (micro-crystals). Intermediate acidic rocks lacking quartz include syenite pegmatite, syenite, syenite porphyry, and trachyte. Soils generally are acidic and podzolization is more fully developed.
Intrusive-intermediate (Ii)	Intermediate composition plutonic rocks that have dark-colored mineral assemblages with significant amounts of potassium, calcium, sodium, aluminum, iron and magnesium. Intermediate rocks dominated by potassium and plagioclase feldspars include monzomite pegmatite, quartz monzonite, quartz monzomite porphyry, quartz latite, monzonite, monzonite porphyry, and latite. Soils tend to be neutral to alkaline.
Intrusive-mafic (Im)	Intermediate and mafic plutonic rocks that have dark-colored mineral assemblages with significant amounts of calcium, sodium, aluminum, iron and magnesium. Mafic rocks dominated by pyroxene and plagioclase feldspars include diorite pegmatite; quartz diorite and diorite; quartz diorite, diorite, dacite, and andesite porphyrys; and dacite and andesite. Soils tend to be neutral to alkaline.
Intrusive-ultramafic (Iu)	Ultramafic rocks are rich in olvine and pyroxene and include hornblendite, pyroxenite, dunite, peridotite (olivine), and serpentine. Plant growth tends to be minimal due to lack of calcium and phosphorus and high heavy metal concentrations.
Metamorphic, carbonate (Nc)	Metacarbonate sedimentary rocks consisting essentially of calcite and/or dolomite. Rock is primarily marble.
Metamorphic, noncarbonate (Nn)	A diverse group of metasedimentary, metapelitic, and metavolcanic rocks that lack carbonates. Metasedimentary include metaconglomerate, metagraywacke, phyllite, slate, quartzite, and schist (K, Mg, Fe, Al rich), while marble may be a minor component. Metavolcanic rocks include greenschist, greenstones, schists, amphibolite, olivine, and phyllite.
Metamorphic, mixed (Nm)	A mixture of interspersed carbonate and noncarbonated metamorphic rocks that cannot be mapped separately.
Bedrock Complex (BC)	Complex mixtures of highly interspersed patches of rocks with widely varying lithologies.

[1] Intrusive igneous bedrock classification from NRCS (2002).

Appendix Table 4. Descriptions of ecological landscapes, and their dominant geomorphology, soils, and vegetation.

Landscape	Description
Arctic Rocky Acidic Alpine	Alpine areas comprised of non-carbonate bedrock, hillside colluvium, and talus on upper slopes and crests at high elevations in the Arctic. Common bedrock types include granite, schist, conglomerate, sandstone and shale. Soils are predominantly rubbly or blocky, excessively to moderately well drained, and acidic (pH<5.6). Permafrost is present but often difficult to determine in rocky soils. Vegetation varies from crustose lichen on outcrops, to dryas–lichen and ericaceous-lichen dwarf shrub tundra on rocky ridges, cassiope dwarf shrub tundra on north-facing slopes and in snowbeds, and moist sedge–birch tundra on moist slopes.
Arctic Rocky Alkaline Alpine	Alpine areas in the Brooks Range and foothills comprised of hillside colluvium, talus, and residual soils on moderately steep to very steep slopes and at high elevations in the Arctic. Bedrock is dominated by carbonate sedimentary and metamorphic rocks, including limestone and marble. Soils are predominantly rubbly or blocky, excessively to well drained, and alkaline (pH>7.3). Permafrost is present but often difficult to determine in rocky soils. Vegetation varies along a gradient from barren outcrops, to dryas–lichen dwarf shrub tundra on exposed sites, and to moist sedge–dryas tundra on moister sites.
Arctic Rocky Acidic-Alkaline Alpine	Areas with interspersed Arctic Rocky Acidic Alpine and Arctic Rocky Alkaline Alpine landscapes that could not be mapped separately. The bedrock includes a mixture of non-carbonate and carbonate sedimentary rocks in close association. See the individual landscapes for descriptions.
Arctic Rocky Circumneutral Alpine	Alpine areas in the Brooks Range and foothills comprised of hillside colluvium, talus, and residual soils on mafic volcanic and intrusive bedrock in the Arctic. Soils are predominantly rubbly or blocky, excessively to well drained, and circumneutral (pH 5.6–7.3). Vegetation varies along a gradient from barren outcrops, to dryas–lichen dwarf shrub tundra on exposed sites, and to moist sedge–dryas tundra on moister sites. This type is notable for the abundance of open tall alder on lower slopes below alpine.
Arctic Rocky Ultramafic Alpine	Barren areas on ultramafic plutonic rocks above tree line in the Brooks Range that typically have dark-colored mineral assemblages with abundant iron and magnesium. Soils are rocky, excessively drained, lacking in surface organic accumulations, and are neutral to alkaline. Soils usually have high levels of trace metals. Areas usually are devoid of vegetation, in part due to the lack of phosphorus and to trace metals.
Arctic Rocky Glaciated Upland	Arctic areas with kame and kettle topography on late-Pleistocene glacial deposits (Itkillik I and II glaciations) in mountain valleys and at the outlet of large valleys in the foothills. Soils are gravelly to rubbly and excessively drained on ridges, fine-grained and peat-rich in depressions, and frequently alkaline due to presence of carbonate rocks. Permafrost is present at depths of 0.5 to 2 m, and buried glacial ice can be present. Vegetation varies along a gradient from dryas–lichen dwarf shrub tundra on exposed sites, to moist sedge–dryas tundra on gentle slopes, occasionally tussock tundra on gentle slopes, cassiope dwarf shrub tundra in snowbeds, open low willow shrub in active slumps, and to wet sedge meadow tundra in depressions. Deep glacial thermokarst lakes are abundant.
Arctic Peaty Glaciated Upland	Rounded ridges and broad swales on middle Pleistocene glacial deposits (Sagavanirktok River, Anaktuvuk River, and Gunsight Mountain glaciations) in the foothills, usually at openings of large mountain valleys in the Arctic. Topography is subdued from long periods of mass wasting and kettle lakes are uncommon. The drift is often covered with thin loess deposits. Soils are peat-rich to loamy, poorly drained, and acidic. Vegetation varies from open low mixed shrub-sedge tussock tundra and open low shrub birch–willow on ridges and upper slopes, to closed low willow and wet sedge meadow tundra in water tracks and swales, and to closed low shrub birch–ericaceous shrub and wet sedge meadow tundra on flat low-lying basins.

Landscape	Description
Arctic Rocky Upland	Steep to gentle slopes on bedrock controlled foothills in the Arctic with small headwater streams. Bedrock is mostly noncarbonate sedimentary rocks. Soils are gravelly to rubbly and excessively drained on ridges to stony silt on colluvial slopes. Permafrost is present at depths of 0.5 to 2 m. Vegetation varies along a gradient from dryas–lichen dwarf shrub tundra and ericaceous dwarf shrub tundra on exposed sites, to moist sedge–birch tundra and open low birch–willow shrub on upper and mid-slopes, occasionally tussock tundra on gentle slopes, and to open low willow shrub and wet sedge meadow tundra in water tracks and small drainages. Lakes are rare.
Arctic Silty Upland	Gently rolling hills and basins underlain by extremely ice-rich, late Pleistocene loess in the lower foothills in the Arctic. Soils are silty, often with a thick, organic-rich surface layer, poorly drained, and acidic. Permafrost occurs within 1 m and is extremely ice rich, with a large volume of ice wedges of Pleistocene age extending 20 m or more in depth. Vegetation is predominantly open low mixed shrub–sedge tussock tundra on gentle slopes, although open low willow shrub and wet sedge meadow tundra occurs in drainages. Deep thermokarst lakes are abundant.
Arctic Sandy Lowland	Gently undulating lowlands in the Arctic associated with large eolian sand sheets and dunes deposited during the Late Pleistocene. Soils are sandy, well drained on ridges to poorly drained in swales, usually with thin surface organics, and mostly circumneutral. Vegetation varies from cassiope dwarf shrub tundra on dune ridges, to sedge–willow tundra and tussock tundra on gentle slopes, and to wet sedge meadow tundra in in swales. Lakes in interdune depressions are abundant.
Arctic Peaty Lowland	Low-lying flats and lower slopes on drained-lake basins, abandoned floodplains, colluvium, and coastal plain deposits in the Arctic. Soils typically are poorly drained, have moderately thick to thick surface organics over silts and sands, and are usually circumneutral to alkaline, but can be acidic on old terrain. Permafrost usually occurs within 1 m of the soil surface. Vegetation varies along a gradient from dryas dwarf shrub tundra on windswept ridges, to tussock tundra and moist sedge-dryas tundra on gentle slopes, wet sedge meadow tundra in swales and drained-lake basins, and to fresh grass marsh in shallow water. Shallow lakes are abundant.
Arctic Silty Lowland	Gently rolling hills and basins underlain by extremely ice-rich, late Pleistocene loess in the upper coastal plain in Arctic regions. Soils are silty, often with a thick, organic-rich surface layer, poorly drained, and circumneutral. Permafrost occurs within 1 m and is extremely ice rich, with a large volume of ice wedges of Pleistocene age that extend 20 m or more in depth. Vegetation is predominantly tussock tundra on gentle slopes, although open low willow shrub and wet sedge meadow tundra occurs in drainages. Deep thermokarst lakes are abundant.
Arctic Gravelly Riverine	Floodplains with active to inactive coarse channels deposits along braided rivers and fluvial fans. They are mostly associated with higher energy streams in the foothills or on narrow coastal plains near the mountains in the Arctic. Soils are gravelly and well drained on early on point bars, poorly drained on older floodplains, and circumneutral to alkaline. Vegetation from partially vegetated riverbars, to open and closed tall willow on well-drained margins, open and closed low willow and low shrub birch-willow shrub on moderately well-drained overbank deposits, dryas dwarf shrub tundra on old gravelly terraces, moist sedge–dryas tundra on distal fine-grained overbank deposits, and to wet sedge–willow tundra in abandoned channels and wet basins. The rivers have mostly clear flowing water and oxbow lakes are abundant.
Arctic Sandy Riverine	Floodplains with sandy channels and overbank deposits in the Arctic along low to moderate energy streams on the Beaufort Coastal Plain, mostly associated with the Pleistocene sand sea in the Ikpikpuk area. Soils are sandy and well drained on point bars, but poorly drained on older floodplains. Permafrost occurs at 0.5 to 1.2 m depths, and is mostly ice-poor. Vegetation varies from barren sandbars, to moist seral grass–herb meadow and open tall willow shrub on sand bars and active dunes, dryas dwarf shrub tundra and cassiope dwarf shrub tundra on inactive dunes, moist sedge–dryas tundra on moderately well-drained flats, wet sedge meadow tundra on poorly drained flats, and to fresh grass marsh in oxbow ponds. Rivers are mostly clear water.

Landscape	Description
Arctic Freshwater	Shallow (<1.5 m) and deep (≥1.5 m) lakes associated with thawing of ice-rich permafrost, impoundment in depressions on sand sheets, and in bedrock controlled uplands in the Arctic. Shallow ponds freeze to the bottom during winter, thaw by early to mid-June, and are warmer than deep lakes. Deep lakes do not freeze to the bottom during winter in deeper centers. Sediments are loamy to sandy. Only very large lakes are mapped separately.
Arctic Gravelly Coast	Salt-affected areas along the Beaufort and Chukchi sea coasts with active and inactive marine beaches and coastal sand dunes. The soils are gravelly to sandy with little to no surface organics, excessively to somewhat excessively well drained, circumneutral to alkaline, and brackish. Permafrost is found in the upper 2 m of the soil profile in this soil landscape. Vegetation varies from barren wave-washed beaches and spits, to early successional dunegrass and mixed herbs meadows above high tide, crowberry dwarf shrub tundra on older deposits, and to moist sedge-dryas tundra in swales.
Arctic Silty Coast	Low-lying, salt-affected areas on tidal flats, deltas, and breached-lake basins that experience flooding by seawater in the Arctic. The vegetated surface is non-patterned or has degrading polygonal troughs, and small tidal ponds frequently are interspersed within the meadows. Soils are silts or loamy sands, poorly drained, and lack surface organics on barren areas with active deposition or have thick surface organic horizon on old floodplains and basins. Soils are circumneutral and slightly brackish to saline. Permafrost occurs in the upper meter of the soil. Vegetation varies from barrens mudflats and halophytic sedge–grass wet meadows on active flats, to Elymus meadows and halophytic willow dwarf shrub on levees and delta dunes. Wet sedge meadow tundra is common on flats only slightly affected by salts.
Arctic Coastal Water	Shallow (<2 m) estuaries, lagoons, and embayments along the coast of the Beaufort and Chukchi Seas in the Arctic. Winds, tides, river discharge, and icing create dynamic changes in physical and chemical characteristics. Salinity ranges from nearly fresh near rivers to saline in unprotected areas. Tidal ranges normally are small (<0.2 m) along the Beaufort and moderate (0.5–1 m) along the Chukchi Seas, but storm surges may raise sea level as much as 2–3 m. Bottom sediments are mostly unconsolidated mud and sand. The ice-free period extends from July until October.
Arctic Marine Water	Deep (~>2 m) marine waters of the Beaufort and Chukchi Seas outside of lagoons and barrier islands. Ice coverage is highly variable from permanent pack ice to seasonally ice free areas.
Boreal Rocky Acidic Alpine	This landscape is similar in geomorphology and vegetation to the Arctic Rocky Acidic Alpine, but differs in that the lower elevations are bounded by white spruce woodlands, or low and tall shrubs. See Arctic Rocky Acidic Alpine for soil and vegetation characteristics.
Boreal Rocky Alkaline Alpine	This landscape is similar in geomorphology and vegetation to the Arctic Rocky Alkaline Alpine, but differs in that the lower elevations are bounded by white spruce woodlands, or low and tall shrubs. See Arctic Rocky Alkaline Alpine for soil and vegetation characteristics.
Boreal Rocky Circumneutral Alpine	Alpine areas in the boreal region of Brooks Range and foothills comprised of hillside colluvium, talus, and residual soils on mafic volcanic and intrusive bedrock. Soils are predominantly rubbly or blocky, excessively to well drained, and circumneutral. Vegetation is similar to that of Alpine Rocky Circumneutral Alpine, but there is little information on this landscape.
Boreal Rocky Ultramafic Alpine	Barren areas on ultramafic plutonic rocks above tree line in the Brooks Range in the boreal region that typically have dark-colored mineral assemblages with abundant iron and magnesium. Soils are rocky, excessively drained, lacking in surface organic accumulations, and are neutral to alkaline. Some areas have high levels of trace metals. Vegetation is similar to that of Alpine Rocky Ultramafic Alpine, but there is little information on this landscape.
Boreal Rocky Glaciated Upland	Areas with kame and kettle topography in mountain valleys and at the mouths of large valleys in the foothills in the boreal region that occur on late-Pleistocene glacial deposits (equivalent to Itkillik I and II in northern Brooks Range). Soils are gravelly to rubbly and excessively drained on ridges to fine-grained and peat-rich in depressions, and are usually acidic to circumneutral.

Landscape	Description
Boreal Rocky Glaciated Upland (cont.)	Permafrost usually is present at depths of 0.5 to 2 m, but is difficult to determine because of rocky soils. Buried glacial ice can be present. Diverse vegetation includes: open aspen forests, open balsam poplar forests, and open white spruce forests that are often lichen-rich on well drained ridges and slopes; closed low shrub birch–ericaceous shrub on both well and poorly drained soils; and subarctic lowland sedge–moss bog meadow in depressions. Fire is an important factor is creating a mosaic of early to late successional stages. Deep thermokarst lakes from recent or old collapse of buried glacial ice are common.
Boreal Peaty Glaciated Upland	Areas with rounded ridges and swales at the mouths of large valleys in the foothills associated with middle or early Pleistocene glacial deposits (equivalent to Sagavanirktok and Anaktuvuk glaciations in northern Brooks Range). Due to long periods of mass wasting the topography is subdued and kettle lakes are uncommon. The drift is often covered thin loess deposits. Soils are peat-rich to loamy, poorly drained, and acidic. Permafrost usually is present at <1 m depth. Vegetation varies from open white spruce forests and open black spruce forests on moderately well drained ridges and slopes; closed low shrub birch–ericaceous shrub on both well and poorly drained soils, and open mixed low shrub–sedge tussock bog meadows on poorly drained lower slopes; and subarctic lowland sedge–moss bog meadow in depressions. Fire creates a mosaic of early to late successional stages. Deep lakes are uncommon. Often the landscape is a mosaic of tundra and forest vegetation.
Boreal Rocky Upland	Steep to gentle slopes on bedrock controlled mountain slopes, foothills, and low hills in the boreal region. Bedrock is mostly noncarbonate sedimentary rocks. Soils are gravelly to rubbly and excessively drained on ridges to stony silt on colluvial slopes. Permafrost is present on north-facing slopes, and generally absent on other aspects. Vegetation is a mosaic of post-fire successional stages that includes burned barrens, fireweed meadow, bluejoint meadow, low shrub birch–willow shrub, low and tall willow, tall alder-willow, open and closed aspen forest, open white spruce forest, and, rarely, open black spruce forest.
Boreal Sandy Upland	Gently rolling to abrupt ridges and swales associated with inactive and active sand dunes in the boreal region. Soils are sandy and excessively to somewhat excessively drained. Active dunes typically are alkaline, while old stabilized dunes are acidic. Permafrost is absent on active dunes but is usually present at 1–2 m on inactive dunes. Vegetation varies from barren areas on active dunes, to dryas-lichen dwarf shrub on exposed ridges, open aspen forest, open birch forest, white spruce woodland (with abundant lichens), and to subarctic lowland sedge wet meadow in swales. Lakes in inter-dunal depressions are common.
Boreal Silty Lowland	Gently rolling hills and basins underlain by extremely ice-rich, late Pleistocene loess in low-lying areas near glaciated terrain in the boreal region. Soils are silty, often with a thick organic-rich surface layer, poorly drained, and acidic. Permafrost occurs within 1 m and is extremely ice rich, with a large volume of ice wedges of Pleistocene age that extend 20 m or more in depth. Vegetation includes open black spruce forest, low shrub birch–willow shrub, and open mixed low shrub–sedge tussock bog meadows. Thermokarst depressions are abundant and support subarctic lowland sedge–moss bog meadow and open low ericaceous shrub bog. Deep thermokarst lakes are abundant.
Boreal Peaty Lowland	Flat to gently sloping valleys, basins, and flats formed on colluvium, retransported, eolian silt, and abandoned floodplain deposits, often with thick organic deposits associated with thermokarst terrain. Soils have thick peats over silts, are poorly drained, and acidic. Vegetation on permafrost-affected terrain varies from open black spruce, to closed low shrub birch–ericaceous shrub on slopes, and to open mixed low shrub–sedge tussock bog meadows. Thermokarst is abundant with round, ombrotrophic thermokarst bogs that support subarctic lowland sedge–moss bog meadow, open low ericaceous shrub bog, and subarctic lowland sedge wet meadow, while linear, minerotrophic thermokarst fens support fresh herb marsh, subarctic lowland sedge wet meadow, and subarctic lowland herb bog meadow.

Landscape	Description
Boreal Gravelly Riverine	Flat areas on active and inactive floodplains in the boreal region subject to frequent flooding. Soils are gravelly, well-drained, and alkaline along the active channels, and are loamy, moderately well drained with moderately thick surface organics, and circumneutral on older floodplains. Permafrost is mostly absent on the active floodplain to discontinuous on the older floodplain. Vegetation varies from moist seral grass–herb meadow and closed tall alder-willow shrub on riverbars, and to closed balsam poplar forest, closed balsam poplar–white spruce forest, and open white spruce forest on loamy overbank deposits. Oxbow lakes and abandoned channels support fresh pondweed, fresh herb marsh, fresh grass marsh, and fresh sedge marsh. Large distal portions of the floodplain that have abandoned floodplain cover deposits with black spruce vegetation and permafrost are grouped with Boreal Peaty Lowlands.
Boreal Freshwater	Large, deep freshwater lakes are mostly associated with moraine-damned valleys in the boreal region of the Brooks Range. Water does not freeze to the bottom during winter. Sediments are mostly rocky with thin surface layers of fine-grained sediment. These lakes have distinct outlets or connections to rivers. Only very large lakes are mapped separately. Shallow thermokarst lakes are abundant in Boreal Peaty Lowlands and deep morainal lakes are abundant in Boreal Rocky Glaciated Uplands but are not mapped.

Appendix Table 5. Tabular listing of main characteristics of ecological subsections mapped for northern Alaska, grouped by ecoregion (in bold) and ecosection (in italics).

Name	Physiography	General Geology	Lithology	Area (km^2)
Beaufort Sea				**10401.3**
Central Beaufort Offshore Water				*4900.6*
Central Beaufort Offshore Water (10-20 m)	Marine Water	Marine water	Marine Water	3751.7
Central Beaufort Offshore Water (5-10 m)	Marine Water	Marine water	Marine Water	1148.9
Eastern Beaufort Offshore Water				*1720.5*
Eastern Beaufort Offshore Water (10-20 m)	Marine Water	Marine water	Marine Water	1247.0
Eastern Beaufort Offshore Water (5-10 m)	Marine Water	Marine water	Marine Water	473.5
Western Beaufort Offshore Water				3780.2
Western Beaufort Offshore Wat. (10-20 m)	Marine Water	Marine water	Marine Water	2731.2
Western Beaufort Offshore Water (5-10 m)	Marine Water	Marine water	Marine Water	1049.0
Beaufort Sea Coast				**8865.6**
Colville Coast				*2212.1*
Colville Inner Delta	Floodplain	Fluvial, young	Silt, sand, gravel	359.0
Colville Outer Delta	Coast	Marine, young	Mud	328.3
Harrison Bay Coast	Coast	Marine, young	Mud	54.4
Harrison Bay Nearshore Water	Coast	Coastal water	Coastal Water	1326.6
Kogru Bay	Coast	Coastal water	Coastal Water	143.9
Icy Coast				*63.1*
Blow Lagoon	Coast	Coastal water	Coastal Water	14.0
Yukon Nearshore Water	Coast	Coastal water	Coastal Water	19.5
Komakuk Coast	Coast	Marine, young	Gravel, mud	29.6
Ikpikpuk Coast				*3976.8*
Admiralty Bay	Coast	Coastal water	Coastal Water	645.2
Cape Halkett Neashore Water	Coast	Coastal water	Coastal Water	172.0
Elson Lagoon	Coast	Coastal water	Coastal Water	331.7
Ikpukpuk-Meade Deltas	Coast	Marine, young	Mud	624.6
Simpson-Halkett Coast	Coast	Glaciomarine	Peat, Pebbly Silt	1433.9
Smith Bay	Coast	Coastal water	Coastal Water	59.1
Smith Bay Nearshore Water	Coast	Coastal water	Coastal Water	284.7
Elson Lagoon Coast Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	425.6
Leffingwell Coast				*641.7*
Aichilik-Kongakut Deltas	Coast	Marine, young	Mud	37.2
Barter Island	Coastal Plain	Marine, old	Peat, pebbly silty sand	11.5
Barter Lagoon	Coast	Coastal water	Coastal Water	212.6
Beaufort Lagoon	Coast	Coastal water	Coastal Water	143.7
Camden Bay Coast	Coast	Marine, old	Peat, pebbly silty sand	9.1
Canning Delta	Coast	Marine, young	Mud	72.2
Canning Nearshore Water	Coast	Coastal water	Coastal Water	103.1
Hulahula Delta	Coast	Marine, young	Mud	34.6
Jago Delta	Coast	Marine, young	Mud	17.8
Stefansson Coast				*1971.8*
Kuparuk Delta	Coast	Marine, young	Mud	21.4
Mikkelsen Bay Coast	Coast	Marine, young	Mud	72.4
Prudhoe Bay Coast	Coast	Marine, young	Mud	36.5
Sagavanirktok Delta	Coast	Marine, young	Mud	171.4
Simpson Lagoon	Coast	Coastal water	Coastal Water	264.2
Simpson Lagoon Coast	Coast	Marine, young	Mud	19.7
Stefansson Sound	Coast	Coastal water	Coastal Water	1386.3
Beaufort Coastal Plain				*60074.4*
Central Beaufort Coastal Plain				10000.0
Canning Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	257.5
Canning Upper Coastal Plain	Coastal Plain	Glaciofluvial, old	Peat, silt, sand, gravel	549.8
Colville Lower Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	805.1
Colville Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	382.9

Name	Physiography	General Geology	Lithology	Area (km^2)
Itkillik Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	182.6
Kachemach Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	8.2
Kadleroshilik Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	58.7
Kuparuk Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	1263.8
Kuparuk Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	406.5
Miluveach Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	15.1
Miluveach Lower Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	382.7
Miluveach Upper Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	761.7
Sagavanirktok Coastal Plain	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	1130.9
Sagavanirktok Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	512.7
Shaviovik Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	1769.4
Shaviovik Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	81.3
Ugnuravik Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	1282.9
Colville Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	148.2
Eastern Beaufort Coastal Plain				*4698.1*
Aichilik Coastal Plain	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	1145.9
Aichilik-Kongakut Lowland Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	319.4
Camden Bay Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	192.4
Camden Bay Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	31.8
Clarence Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	121.1
Clarence Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	14.0
Demarcation Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	23.8
Hulahula Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	45.5
Jago Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	1713.5
Jago Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	95.0
Kadlerochilik Lower Floodplain	Coastal Plain	Fluvial, young	Silt, sand, gravel	3.3
Komakuk Coastal Plain	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	139.9
Malcolm Lower Floodplain	Coastal Plain	Fluvial, young	Silt, sand, gravel	24.5
Niguanak Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	8.5
Niguanak Hills	Upland	Colluvium, upland	Peat, rocky silt	93.6
Okpilak Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	23.7
Okpilak Uplands	Upland	Eolian silt	Silt	19.8
Sadlerochit Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	62.7
Turner Lowland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	1.9
Sadlerochit-Hulahula Lowland	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	365.6
Camden Bay Lowland	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	86.8
Okpilak-Jago Lowland	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	165.5
Western Beaufort Coastal Plain				*45376.4*
Avalik Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	27.6
Avalik Middle Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	4384.1
Cape Halkett Lower Coastal Plain	Coastal Plain	Glaciomarine	Peat, Pebbly Silt	747.1
Fish Creek Lower Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	143.1
Fish-Judy Creek Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	444.2
Ikpikpuk Lower Coastal Plain	Coastal Plain	Fluvial, old	Peat, silt, sand, gravel	1715.1
Ikpikpuk Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	1829.3
Ikpikpuk Middle Coastal Plain	Coastal Plain	Eolian sand	Sand	11046.3
Ikpikpuk Upper Coastal Plain	Coastal Plain	Eolian sand	Sand	1988.1
Inaru Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	50.7
Ivisaruk Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	20.0
Kalikpik Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	17.1
Kasegaluk Lower Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	778.4
Kasegaluk Lower Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	42.1
Kasegaluk Middle Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	2266.9
Kealok Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	46.9
Kikiakrorak Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	104.3
Kogosukruk Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	46.7

Name	Physiography	General Geology	Lithology	Area (km^2)
Kokolik Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	158.3
Meade Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	494.0
Meade Middle Coastal Plain	Coastal Plain	Eolian sand	Sand	921.5
Oumalik Upper Coastal Plain	Coastal Plain	Eolian silt	Silt	2747.8
Teshekpuk Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	21.3
Teshekpuk Lower Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	867.1
	Lacustrine	Freshwater	Water	871.3
Topagorak Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	262.4
Ublutuoch Upper Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	1313.4
Utukok Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	128.3
Utukok Upper Coastal Plain	Coastal Plain	Eolian silt	Silt	3852.5
Wainwright Lower Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	8040.5
Chukchi Sea				***10736.7***
Northern Chukchi Offshore Water				*7910.2*
Northern Chukchi Offshore Water	Coast	Coastal water	Marine Water	1553.3
Northern Chukchi Offshore Wat. (10-20 m)	Marine Water	Marine water	Marine Water	6356.9
Southern Chukchi Offshore Water				*2661.0*
Souther Chukchi Offshore Water (10-20 m)	Marine Water	Marine water	Marine Water	1799.9
Souther Chukchi Offshore Water (5-10 m)	Marine Water	Marine water	Marine Water	861.1
Kotzebue Sound Nearshore Water				*165.5*
Kotzebue Sound Nearshore Water	Marine Water	Marine water	Marine Water	96.3
Kotzebue Sound Coastal Water	Coast	Coastal water	Coastal Water	69.2
Southern Chukchi Coast				**1324.6**
Kotzebue Coast				*279.2*
Noatak Delta	Coast	Marine, young	Mud	208.9
Sheshalik Lagoon	Coast	Marine, young	Gravel, mud	70.3
Krusenstern Coast				*1045.4*
Cape Lisburne Coast	Coast	Marine, young	Gravel, mud	27.7
Cape Seppings Coast	Coast	Marine, young	Gravel, mud	15.8
Cape Thompson Coast	Coast	Marine, young	Gravel, mud	4.2
Imikruk Coast	Coast	Marine, young	Gravel, mud	147.8
Kivilina-Kotlik Lagoons	Coast	Marine, young	Gravel, mud	65.9
Krusenstern Lagoon	Coast	Marine, young	Gravel, mud	119.5
Krusenstern Nearshore Water	Coast	Coastal water	Coastal Water	190.5
Lisburne Nearshore Water	Coast	Coastal water	Coastal Water	288.6
Point Hope Coast	Coast	Marine, young	Gravel, mud	185.5
Northern Chukchi Coast				**2354.3**
Wainwright Coast				*2354.3*
Barrow Coast	Coast	Marine, young	Gravel, mud	45.0
Barrow Nearshore Water	Coast	Coastal water	Coastal Water	64.9
Ksegaluk Lagoon	Coast	Marine, young	Gravel, mud	1153.0
Kuk Inlet	Coast	Coastal water	Coastal Water	329.8
Peard Bay Coast	Coast	Marine, young	Gravel, mud	716.0
Wainwright Nearshore Water	Coast	Coastal water	Coastal Water	45.7
Kobuk Ridges and Valley				**26042.4**
Kiana Hills				*2860.5*
Avingoriak Hills	Upland	Colluvium, upland	Peat, rocky silt	186.4
Igisukruk Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	3.0
Igisukruk Lowland	Upland	Colluvium, upland	Peat, rocky silt	160.1
Kiana Hills	Upland	Metamorphic, noncarbonate	Metamorphic, noncarbonate	609.7
Noatak Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	35.1
Shiliak Hills	Upland	Colluvium, upland	Peat, rocky silt	224.9
Shiliak Mountains	Mountain, Rounded	Metamorphic, noncarbonate	Metamorphic, noncarbonate	191.0
Squirrel Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	108.5
Squirrel Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	237.3

Name	Physiography	General Geology	Lithology	Area (km^2)
Squirrel Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	707.7
Kiana Lowland	Lowland	Colluvium, basin	Peat, silt	396.7
Kobuk Uplands				*12566.4*
Ahnewetut Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	5.7
Ahnewetut Wetlands	Lowland	Colluvium, basin	Peat, silt	141.9
Hunt-Akillik Floodplain	Floodplain	Fluvial, young	Sand	10.8
Hunt-Akillik Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	45.5
Inerevuk Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	676.0
Kaligurichеark Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	24.6
Kallarichuk Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	18.2
Kitlik Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	254.2
Kobuk Dune Floodplains	Floodplain	Fluvial, young	Sand	11.7
Kobuk Floodplain	Floodplain	Fluvial, young	Sand	0.8
Kobuk Great Sand Dunes	Upland	Eolian sand	Sand	61.1
Kobuk Little Sand Dunes	Upland	Eolian sand	Sand	7.6
Kobuk Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	1002.5
Kobuk Middle Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	244.6
Kobuk Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	1502.9
Kobuk Sand Sheets	Lowland	Eolian sand	Sand	47.5
Kobuk Very Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	1981.1
Lockwood Hills	Upland	Colluvium, upland	Peat, rocky silt	1067.3
Narvak Mountains	Mountain, Rugged	Intrusive, mafic	Intrusive, mafic	597.1
Niaktuvik Floodplain	Floodplain	Fluvial, young	Sand	6.1
Nigeruk Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	11.4
Nigeruk Plain	Lowland	Eolian silt	Silt	736.0
Salmon-Kitlik Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	51.1
Tuktuksuk Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	38.9
Waring Hills	Upland	Colluvium, upland	Peat, rocky silt	928.6
Waring Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Peat, rocky silt	612.7
Lockwood Lowland	Lowland	Colluvium, basin	Peat, silt	43.0
Kobuk River Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	23.0
Selawik Old Glaciated Lowland	Glaciated Upland	Glacial, old	Peat, silt, diamicton	159.5
Angayucham Hills	Upland	Colluvium, upland	Peat, rocky silt	95.5
Kobuk Stabilized Dunes	Upland	Eolian sand	Sand	595.8
Kobuk Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	1563.6
Koyukuk Uplands				*7294.5*
Alatna Hills	Upland	Colluvium, upland	Peat, rocky silt	1426.8
Koyukuk Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	452.7
Koyukuk Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	238.9
Koyukuk Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	2555.9
Koyukuk Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	1515.7
Sozhekla Uplands	Upland	Colluvium, upland	Peat, rocky silt	552.9
Angayucham Hills	Upland	Colluvium, upland	Peat, rocky silt	474.4
Deadman Hills	Mountain, Rounded	Volcanic, mafic-older	Volcanic, mafic-older	77.3
Noatak Lowland				*3321.0*
Lower Noatak Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	476.4
Lower Noatak Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	1003.1
Noatak Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	562.9
Noatak Lowland Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	163.4
Lower Noatak Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	1115.3
North Ogilvie Mountains				**7977.2**
North Ogilve Mountains				*7977.2*
Porcupine Hills	Upland	Colluvium, upland	Peat, rocky silt	3715.4
Salmon Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	24.9
Salmon Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	4236.9

Name	Physiography	General Geology	Lithology	Area (km^2)
Yukon-Old Crow Basin				**7164.3**
Old Crow Flats				*247.2*
Bluefish Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	53.2
Crow Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	43.9
Old Crow Flats	Lowland	Fluvial, old	Peat, silt, sand, gravel	150.2
Porcupine Lowland				*6891.6*
Coleen Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	98.0
Porcupine Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	650.5
Sheenjek Lower Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	963.8
Sheenjek Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	169.5
Porcupine Uplands	Upland	Colluvium, upland	Peat, rocky silt	5009.9
Rampart Lowland				*25.4*
Black Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	25.4
Davidson Mountains				**31905.8**
Old Crow Mountains				*6623.0*
Old Crow Hills	Upland	Colluvium, upland	Peat, rocky silt	1556.2
Old Crow Mountains	Mountain, Rounded	Intrusive, felsic	Intrusive, felsic	1367.1
Rampart Hills	Upland	Colluvium, upland	Peat, rocky silt	1591.3
Thomas Mountains	Upland	Colluvium, upland	Peat, rocky silt	2096.4
Thomas Upland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	12.1
Sheenjek Hills				*9307.9*
Christian Mountain	Upland	Intrusive, ultramafic	Instrusive, ultramafic	109.0
Christian Upland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	48.5
Coleen Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	85.0
Grayling Mountains	Upland	Colluvium, upland	Peat, rocky silt	220.5
Sheenjek Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	103.1
Sheenjek Uplands	Upland	Colluvium, upland	Peat, rocky silt	2617.6
White Snow Uplands	Upland	Intrusive, mafic	Instrusive, mafic	5327.3
Sheenjek Middle Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	55.3
Sheenjek Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	71.9
Coleen Lowland	Lowland	Colluvium, basin	Peat, silt	669.7
Sheenjek Mountains				*15975.0*
Christian Uplands	Upland	Colluvium, upland	Peat, rocky silt	4388.2
Coleen Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	153.0
Coleen Old Glaciated Uplands	Glaciated Valley	Glacial, old	Peat, silt, diamicton	88.5
East Chandalar Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	269.2
East Chandalar Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	1639.6
East Chandalar Young Glaciated Uplands	Glaciated Valley	Glacial, young	Diamicton	998.1
	Lacustrine	Freshwater	Water	23.6
Koness Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	691.9
Martin Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	902.2
Old Woman Hills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1050.4
Sheenjek Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	997.1
Sheenjek Uplands	Upland	Colluvium, upland	Peat, rocky silt	1849.9
Sheenjek Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	185.5
Sheenjek Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	410.1
Thazzik Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	2154.7
Sheenjek Upper Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	98.7
Chandalar Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	74.1
Southern Brooks Range				**56257.8**
Baird Southern Mountains				*1778.7*
Squirrel Foothills	Upland	Colluvium, upland	Peat, rocky silt	33.4
Squirrel Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	40.7
Squirrel Mountains Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	32.9

Name	Physiography	General Geology	Lithology	Area (km^2)
	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1671.6
Chandalar Mountains				*8697.6*
Chandalar Low Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1133.4
Chandalar Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	63.9
Chandalar Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	58.5
Chandalar Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	3234.3
Chandalar Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	0.0
Chandalar Upper Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	50.1
Chandalar Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	357.5
Chandalar Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	1237.2
	Lacustrine	Freshwater	Water	22.5
East Chandalar Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	68.5
East Chandalar Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	481.9
McLellan Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	905.9
Wind Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1083.9
Endicott Southern Mountains				*19756.2*
Alatna Young Glaciated Valley	Glaciated Valley	Glacial, young	Diamicton	45.9
	Lacustrine	Freshwater	Water	13.1
Alatna Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	583.6
Alatna-Koyukuk Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	4127.3
Chandalar Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	254.3
Dietrich Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	2471.4
Doonerak Mountains	Mountain, Rugged	Intrusive, mafic	Intrusive, mafic	402.2
Koyukuk Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	471.7
Koyukuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	3.4
Koyukuk Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	2186.0
Kugrak Crest Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	697.2
McLellan Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	1220.4
Nahtuk Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1206.7
Skajit Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	2086.1
Snowden Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	392.3
Horace Mountains	Mountain, Rugged	Intrusive, felsic	Intrusive, felsic	456.0
Nahtuk Southern Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1640.0
Nahtuk Northern Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1498.5
Junjik Mountains				*9823.2*
Coleen Old Glaciated Valleys	Glaciated Valley	Glacial, old	Peat, silt, diamicton	284.1
Collen Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	94.1
Double Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	768.6
East Chandalar Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	217.5
East Chandalar Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	475.2
Junjik Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	2589.9
Misty Mountains	Mountain, Rugged	Sedimentary, mixed	Sedimentary, mixed	595.9
Old Woman Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	164.4
Sheenjek Crest Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	456.2
Sheenjek Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	52.1
Sheenjek Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	2768.2
Sheenjek Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	116.4
Split Hills	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	80.9

Name	Physiography	General Geology	Lithology	Area (km^2)
Tetsyeh Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	922.9
Western Bear Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	177.2
Eastern Bear Mountains	Mountain, Rugged	Intrusive, felsic	Intrusive, felsic	59.7
Kiana Hills				*594.7*
Squirrel Foothills	Upland	Colluvium, upland	Peat, rocky silt	594.7
Kobuk Mountains				*10557.9*
Akiak Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	37.7
Akiak Foothills	Mountain, Rounded	Metamorphic, noncarbonate	Metamorphic, noncarbonate	1199.2
Akiak Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	1821.5
Akiak Old Glaciated Valleys	Glaciated Valley	Glacial, old	Peat, silt, diamicton	123.7
Anaktok Mountains	Mountain, Rounded	Metamorphic, noncarbonate	Metamorphic, noncarbonate	157.5
Hunt-Akillik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	51.4
Jade Mountains	Mountain, Rugged	Intrusive, mafic	Intrusive, mafic	147.5
Kallarichuk Hills	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	565.3
Klerty Mountains	Mountain, Rounded	Metamorphic, noncarbonate	Metamorphic, noncarbonate	572.9
Kobuk Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	141.4
Kobuk Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	3411.1
Kobuk Old Glaciated Valleys	Glaciated Valley	Glacial, old	Peat, silt, diamicton	151.5
		Glacial, young	Diamicton	662.2
	Lacustrine	Freshwater	Water	39.3
Salmon Hills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	326.7
Shungnak Mountains	Mountain, Rugged	Intrusive, felsic	Intrusive, felsic	156.5
Squirrel Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	7.9
Tukpahlearik Mountains	Mountain, Rounded	Metamorphic, noncarbonate	Metamorphic, noncarbonate	499.4
Tuktuksuk Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	52.4
Tuktuksuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	8.0
Kobuk Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	424.8
Philip Smith Southern Mountains				*2320.8*
Chandalar High Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1646.6
Chandalar Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	39.4
Chandalar Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	391.3
Keche Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	243.4
Schwatka Mountains				*2728.8*
Arrigetch Mountains	Mountain, Rugged	Intrusive, felsic	Intrusive, felsic	1220.3
Kugrak Crest Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1307.3
Schwatka Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	28.5
Schwatka Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	172.7
Northern Brooks Range				**77594.5**
Baird Northern Mountains				*4520.9*
Agashashok Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	351.6
Aklumayuak Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1369.0
Asik Mountain	Mountain, Rounded	Intrusive, ultramafic	Instrusive, ultramafic	60.6
Eli Foothills	Upland	Colluvium, upland	Peat, rocky silt	419.6
Eli Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	209.2
Nakolik Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	405.9
Northern Baird Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	46.0
Tututalak Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1468.0

Name	Physiography	General Geology	Lithology	Area (km^2)
Maiyumerak Mountains	Mountain, Rugged	Volcanic, mafic-older	Volcanic, mafic-older	191.0
Baird Southern Mountains				*19.4*
Squirrel Mountains Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	19.4
British Mountains				*6706.3*
Aickilik Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	873.7
British Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	107.5
British Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	1276.3
Conybeare Mountains	Mountain, Rounded	Sedimentary, mixed	Sedimentary, mixed	200.8
Demarcation Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	93.6
Egaksrak Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	175.8
Ekaluakat Mountains	Mountain, Rounded	Sedimentary, mixed	Sedimentary, mixed	1251.2
Ekaluakat Old Glaciated Valleys	Glaciated Valley	Glacial, old	Peat, silt, diamicton	136.6
Firth Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	19.1
Joe Creek Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	634.9
Leffingwell Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	170.4
Malcolm Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	16.5
Malcolm Mountains	Mountain, Rugged	Sedimentary, mixed	Sedimentary, mixed	1341.8
Reiser Mountains	Mountain, Rugged	Intrusive, mafic	Instrusive, mafic	408.1
DeLong Mountains				*12267.5*
Anisak Hills	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	329.0
Anisak Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	716.0
Anisak Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	79.8
Avan Mountains	Mountain, Rugged	Intrusive, ultramafic	Instrusive, ultramafic	341.9
Bastille Mountains	Mountain, Rugged	Intrusive, mafic	Instrusive, mafic	85.3
Delong Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	272.7
DeLong Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	831.1
Ikalukrok Mountains	Mountain, Rounded	Sedimentary, mixed	Sedimentary, mixed	346.0
Imikneyak Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	688.5
Kaluktavik Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	430.4
Kaluktavik Uplands	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	314.1
Kelly Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1095.1
Kugururok Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	530.3
Kukpowruk Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	5.9
Misheguk Mountains	Mountain, Rugged	Intrusive, ultramafic	Instrusive, ultramafic	647.2
Misheguk Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	275.3
Nigu Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	5.0
Siniktanneyak Mountain	Mountain, Rugged	Intrusive, ultramafic	Instrusive, ultramafic	205.4
Sivukat Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	547.9
Wulik Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	48.1
Wulik Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	427.0
DeLong Northern Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	4045.6
Endicott Northern Mountains				*15820.2*
Anaktuvuk Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1070.5
Anaktuvuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	27.2
Anaktuvuk Young Glaciated Valley	Glaciated Valley	Glacial, young	Diamicton	179.1
Anisak Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	19.6
Aniuk Hills	Mountain, Rounded	Intrusive, mafic	Instrusive, mafic	54.0
Chandler Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	3.5
Endicott Crest Mountains	Mountain, Rugged	Sedimentary,	Sedimentary, noncarbonate	5245.8

Name	Physiography	General Geology	Lithology	Area (km^2)
		noncarbonate		
Endicott Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	24.8
Endicott Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	454.8
Ipnavik Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	4.8
Ipnavik Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1651.4
Killik Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	103.6
Killik Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	2903.3
Killik Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	1052.3
	Lacustrine	Freshwater	Water	19.3
Koyukuk High Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	40.9
Kurupa Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	2.7
Kurupa Old Glaciated Valleys	Glaciated Valley	Glacial, old	Peat, silt, diamicton	25.2
Kurupa Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	83.5
Nigu Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	60.1
Nigu Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	662.6
Nigu Young Glaciated Valley	Glaciated Valley	Glacial, young	Diamicton	631.5
Noatak Old Glaciated Valley	Glaciated Valley	Glacial, old	Peat, silt, diamicton	362.4
Noatak Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	7.5
Nukatpiat Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	900.9
Outwash Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	6.0
Upper Noatak Basin	Lowland	Glaciolacustrine	Peat, silt	222.9
Franklin Mountains				*4166.2*
Canning Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	15.6
Franklin Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	52.1
Franklin Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	2998.9
Franklin Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	280.3
Marsh Fork Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	178.1
Okpilak Mountains	Mountain, Rugged	Intrusive, felsic	Intrusive, felsic	457.1
Romanzof Mountains	Mountain, Rugged	Metamorphic, noncarbonate	Metamorphic, noncarbonate	95.0
Guilbeau Mountains	Mountain, Rugged	Intrusive, mafic	Instrusive, mafic	89.1
Noatak Basin				*7166.0*
Anisak Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	193.9
Avingyak Hills	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	468.1
Avingyak Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	323.6
Iggiruk Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	409.0
Middle Noatak Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	457.6
Noatak Basin Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	201.1
Noatak Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	110.7
Noatak Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	381.9
Noatak Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	1005.1
Upper Noatak Basin	Lowland	Glaciolacustrine	Peat, silt	3127.7
Upper Noatak Old Glaciated Uplands	Glaciated Valley	Glacial, old	Peat, silt, diamicton	487.3
Noatak Mountains				*4884.1*
Angayukaqsraq Mountains	Mountain, Rugged	Metamorphic, mixed	Metamorphic, noncarbonate	184.0
Imelyak Foothills	Upland	Sedimentary, mixed	Sedimentary, mixed	554.9
Imelyak Young Glaciated Uplands	Glaciated Valley	Glacial, young	Diamicton	319.8
Kaluich Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	101.0
Kavachurak Crest Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1144.5
Kavachurak Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	354.6

Name	Physiography	General Geology	Lithology	Area (km^2)
Kunyanak Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	477.6
Natmotirak Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	678.3
Natmotirak Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	496.3
Northern Baird Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	50.3
Ulaneak Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	10.4
Ulaneak Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	473.1
Ulaneak Old Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	39.4
Philip Smith Northern Mountains				*6647.9*
Anaktuvuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	7.4
Anaktuvuk Young Glaciated Valley	Glaciated Valley	Glacial, young	Diamicton	29.9
Itkillik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	24.6
Ivishak Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	704.5
Kanayut Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	462.7
Koyukuk Crest Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	2159.0
Sagavanirktok Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	133.9
Sagavanirktok Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	2353.5
Sagavanirktok Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	772.6
Romanzof Mountains				*13205.7*
Bathtub Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	343.1
Canning Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	76.9
Canning Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	297.7
Echooka Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	789.3
Firth Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	206.8
Ivishak Crest Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1146.9
Ivishak Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	4467.2
Kavik Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	11.7
Kongakut Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	37.9
Kongakut Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1127.5
Kongakut Upper Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	717.9
Mancha Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	754.6
Marsh Fork Uplands	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	552.9
Riggs Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	1744.4
Romanzof Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	3.8
Sagavanirktok Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	122.2
Sagavanirktok Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	357.1
Sheenjek High Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, carbonate	447.9
Sadlerochit Mountains				*2190.3*
Canning Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	43.3
Canning Young Glaciated Valleys	Glaciated Valley	Glacial, young	Diamicton	108.3
Franklin Mountain Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	7.7
Romanzof Young Glaciated Mountains	Glaciated Valley	Glacial, young	Diamicton	57.6
Sadlerochit High Mountain Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	2.8
Sadlerochit Mountains	Mountain, Rugged	Sedimentary, carbonate	Sedimentary, noncarbonate	1149.2
Schrader Mountains	Mountain, Rugged	Sedimentary, noncarbonate	Sedimentary, noncarbonate	821.5
Brooks Foothills				**111921.0**
Krustenstern Coastal Plain				*418.1*
Kotlik Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	41.3
Wulik Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	341.7
Wulik Lower Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	35.1

Name	Physiography	General Geology	Lithology	Area (km^2)
Lisburne Mountains				*2806.7*
Akalolik Mountains	Mountain, Rounded	Metamorphic, noncarbonate	Metamorphic, noncarbonate	418.3
Ipewik Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1198.0
Kukpuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	28.9
Lisburne Headwater Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	8.6
Lisburne Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	1152.9
Lower Central Brooks Foothills				*12120.0*
Anaktuvuk Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	128.7
Chandler Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	68.4
Colville Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	172.2
Itkillik Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	169.8
Kadleroshilik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	36.6
Kuparuk Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	234.2
Kuparuk Uplands	Upland	Colluvium, upland	Peat, rocky silt	3278.5
Sagavanirktok Acidic Uplands	Upland	Eolian silt	Silt	4341.5
Shaviovik MIddle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	132.0
Toolik Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	76.0
Toolik Uplands	Upland	Eolian silt	Silt	5.5
White Hills	Upland	Colluvium, upland	Peat, rocky silt	219.2
Canning Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	86.1
Colville Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	99.4
Sagavanirktok Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	18.1
Itkillik Middle Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	24.5
		Glaciofluvial, old	Peat, silt, sand, gravel	338.3
Sagavanirktok Silty Uplands	Upland	Eolian silt	Silt	2691.0
Lower Eastern Brook Foothills				*1383.1*
Camden Uplands	Upland	Eolian silt	Silt	87.6
Flaxman Upland Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	4.2
Hulahula-Aichilik Uplands	Upland	Eolian silt	Silt	781.7
Jago Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	5.4
Jago Hills	Upland	Colluvium, upland	Peat, rocky silt	95.7
Kongakut Uplands	Upland	Colluvium, upland	Peat, rocky silt	36.1
Tamayariak Uplands	Upland	Eolian silt	Silt	372.4
Lower Western Brooks Foothills				*19440.0*
Avalik Uplands	Upland	Eolian silt	Silt	6933.1
Avalik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	43.7
Awuna Uplands	Upland	Colluvium, upland	Peat, rocky silt	1353.9
Hope Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	142.3
Ikpikpuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	185.5
Kikiakrorak Uplands	Upland	Eolian silt	Silt	1452.8
Kogosukruk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	5.9
Kokolik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	94.9
Kulugra Uplands	Upland	Colluvium, upland	Peat, rocky silt	9010.3
Meade Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	25.1
Prince Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	20.2
Utukok Lowland	Upland	Colluvium, basin	Peat, silt	172.4
Upper Central Brooks Foothills				*33547.6*
Anaktuvuk Lower Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	266.4
Canning Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	94.8
Canning Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	838.5
Canning Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	583.0
Chandler Foothills	Upland	Colluvium, upland	Peat, rocky silt	351.4
Chandler Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	85.1
Chandler Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	202.6
Chandler Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	123.6

Name	Physiography	General Geology	Lithology	Area (km^2)
Colville Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	383.6
Colville Upper Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	195.1
Itkillik Foothills	Upland	Colluvium, upland	Peat, rocky silt	1065.4
Itkillik Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	60.8
Itkillik Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	2355.5
Killik Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	171.6
Killik Foothills	Upland	Colluvium, upland	Peat, rocky silt	1503.3
Killik Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	1736.7
Killik Uplands	Upland	Colluvium, upland	Peat, rocky silt	4971.6
Killik Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	714.8
Kuparuk Middle Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	5.9
Nigu Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	183.5
Nigu Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	570.5
Nuka Uplands	Upland	Colluvium, upland	Peat, rocky silt	497.3
Sagavanirktok Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	382.9
Sagavanirktok Foothills	Upland	Colluvium, upland	Peat, rocky silt	1138.8
Sagavanirktok Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	2859.4
Sagavanirktok Uplands	Upland	Colluvium, upland	Peat, rocky silt	3951.6
Sagavanirktok Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	3013.5
Shaviovik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	80.6
Toolik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	41.1
Killik Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	60.9
		Glaciofluvial, old	Peat, silt, sand, gravel	3512.1
Nigu Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	112.6
Canning Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	50.7
		Glaciofluvial, old	Peat, silt, sand, gravel	23.9
Colville MIddle Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	146.1
Chandler Lowland	Lowland	Glaciofluvial, old	Peat, silt, sand, gravel	78.6
Sagavanirktok Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	21.9
		Glaciofluvial, old	Peat, silt, sand, gravel	224.6
Itkillik Upper Lowland	Lowland	Glaciofluvial, old	Peat, silt, sand, gravel	887.3
Upper Eastern Brooks Foothills				*3809.1*
Aichilik Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	17.5
Camden Uplands	Upland	Eolian silt	Silt	673.8
Canning Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	405.5
Hulahula Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	6.4
Hulahula-Jago Young Glaciated Uplands	Glaciated Upland	Glacial, young	Diamicton	317.1
Jago Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	4.7
Jago Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	989.2
Katakturuk Uplands	Upland	Eolian silt	Silt	217.9
Komakuk Uplands	Upland	Colluvium, upland	Peat, rocky silt	188.8
Kongakut Uplands	Upland	Colluvium, upland	Peat, rocky silt	170.4
Marsh Creek Hills	Upland	Colluvium, upland	Peat, rocky silt	121.6
Okpilak Foothill Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	5.6
Sadlerochit Foothill Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	63.8
Sadlerochit Foothills	Upland	Colluvium, upland	Peat, rocky silt	266.2
Shublik Hills	Upland	Colluvium, upland	Peat, rocky silt	268.8
Katakturuk Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	91.6
Upper Western Brooks Foothills				*33775.3*
Awuna Uplands	Upland	Colluvium, upland	Peat, rocky silt	46.9
Colville Upper Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	203.0
Ipewik Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1061.3
Ipewik Uplands	Upland	Colluvium, upland	Peat, rocky silt	4886.0
Kokolik Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	121.7
Kukpowruk Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	31.7

Name	Physiography	General Geology	Lithology	Area (km^2)
Kukpowruk Mountains	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	666.4
Kukpowruk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	55.6
Kukpuk Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	62.1
Kuna Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	1750.0
Nigu Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	71.5
Nigu Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	18.6
Nigu Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	349.3
Nuka Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	240.9
Nuka Uplands	Upland	Colluvium, upland	Peat, rocky silt	3885.9
Utukok Hills	Upland	Colluvium, upland	Peat, rocky silt	13750.8
Utukok Upper Floodplain	Floodplain	Fluvial, young	Silt, sand, gravel	70.1
Ipewik Lowland	Lowland	Colluvium, basin	Peat, silt	130.4
Utukok Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	5062.5
Nuka Lowland	Lowland	Glaciofluvial, old	Peat, silt, sand, gravel	178.7
		Colluvium, basin	Peat, silt, sand, gravel	993.5
Awuna Lowland	Lowland	Colluvium, basin	Peat, silt	138.4
Wulik Foothills				*4621.1*
Alutunitok Hills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	27.1
Asikpak Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	285.7
Igichuk Hills	Upland	Colluvium, upland	Peat, rocky silt	442.3
Igichuk Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	140.9
Ikalukrok Foothills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	166.0
Ivikrok Mountain	Upland	Intrusive, ultramafic	Instrusive, ultramafic	49.1
Kakagrak Hills	Upland	Sedimentary, carbonate	Sedimentary, carbonate	40.4
Kikmiksok Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	125.8
Kivalina Uplands	Upland	Colluvium, upland	Peat, rocky silt	363.7
Mulgrave Hills	Upland	Sedimentary, noncarbonate	Sedimentary, noncarbonate	138.1
Mulgrave Uplands	Upland	Colluvium, upland	Peat, rocky silt	888.8
Siaktak Mountains	Mountain, Rounded	Sedimentary, noncarbonate	Sedimentary, noncarbonate	198.3
Tahinichok Mountains	Mountain, Rounded	Sedimentary, carbonate	Sedimentary, carbonate	106.6
Wulik Middle Floodplains	Floodplain	Fluvial, young	Silt, sand, gravel	225.5
Wulik Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	1035.4
Kivalina Lowland	Lowland	Fluvial, old	Peat, silt, sand, gravel	197.0
Jade Upland	Upland	Colluvium, upland	Peat, rocky silt	190.6
Kotzebue Sound Lowland				**469.2**
Kotzebue Coastal Plain				*469.2*
Aukulak Coastal Plain	Coastal Plain	Marine, old	Peat, pebbly silty sand	112.9
Kiana Old Glaciated Uplands	Glaciated Upland	Glacial, old	Peat, silt, diamicton	356.3
Grand Total				413089.1