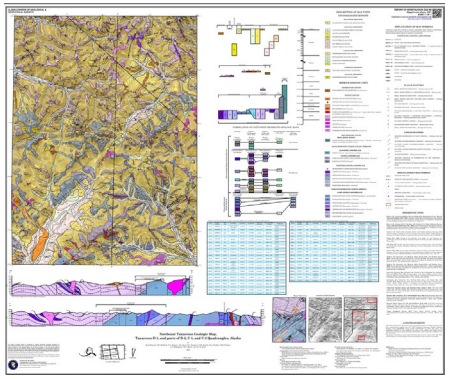
DIGITAL MAPPING TECHNIQUES 2025

The following was presented at DMT'25
May 18 - 21, 2025

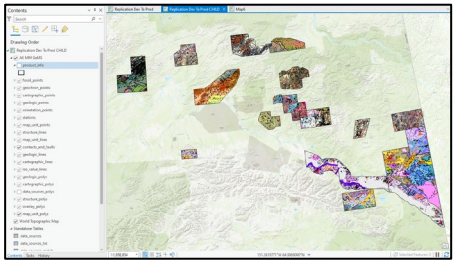
The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2025)
http://ngmdb.usgs.gov/info/dmt/

AK GeMS
Geologic Mapping System



The Alaska Division of Geological and Geophysical Surveys (DGGS) produces and publishes numerous geologic maps each year.

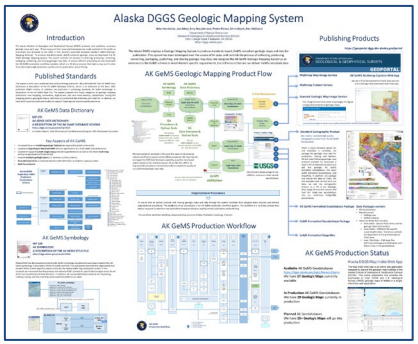


To produce standards-based geologic maps we developed the

AK DGGS Geologic Mapping System

This system controls the process of:
collecting, producing, converting, packaging, publishing, and sharing geologic map data.

Poster View of System



https://doi.org/10.14509/30864

Mike Hendricks, Amy Macpherson, Ally Steinleitner, Pedro Rivera, Chris Wyatt, Simone Montanye and others

Alaska Division of Geological & Geophysical Surveys
3354 College Rd, Fairbanks AK 99709

Alaska DGGS Geologic Mapping System Components

Organizational Procedures

Tools

AK GeMS v2 Data Dictionary

Alaska DGGS Field Event Geodatabases

Mapping Process

Alaska DGGS Single Map AK GeMS Production DBs

Convert & Load

Alaska DGGS Multi Map AK GeMS Geodatabase

Geologic Feature Services

Product Web Page

Digital Data Series (DDS) File Geodatabase Export Snapshots

Cartographic Product

Style

AK GeMS v2 Symbology

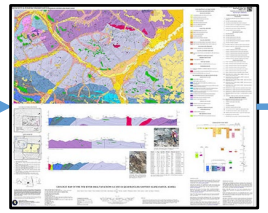
Quality Control

Data Reviewer Rules & Python Tools

Four Categories of Production

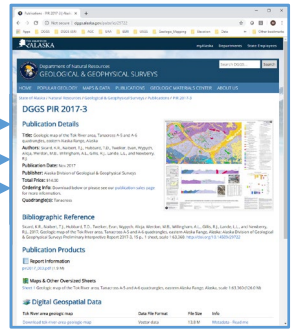
- *New Mapping*
- *Conversions*
- *Digitizations*
- *Compilations*

Print, pdf, & Rasterize



Geologic Map Image Services

Product Web Page



Export

Alaska DGGS Single Map AK GeMS Geodatabase

Convert

USGS Single Map GeMS Geodatabase

To USGS

GeMS Validation

AK GEMS DATA DICTIONARY: A DESCRIPTION OF THE AK GEMS DATABASE SCHEMA, MP 170 V.2
https://dggs.alaska.gov/pubs/id/31172

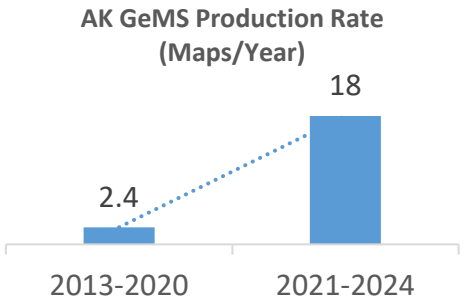
- Report
- Data Dictionary
- Entity-Relationship Diagram
- XML Workspace Document

AK GEMS SYMBOLOGY: A DESCRIPTION OF THE AK GEMS STYLE FILE, MP 169 V.2
https://dggs.alaska.gov/pubs/id/31101

- Report
- AK_GeMS_symbology_documentation_ver_2.xls (Excel)
- AK_GeMS_symbology_ver_2.style (Style File)

AK GeMS Map Production and Conversion

Key Items this past year

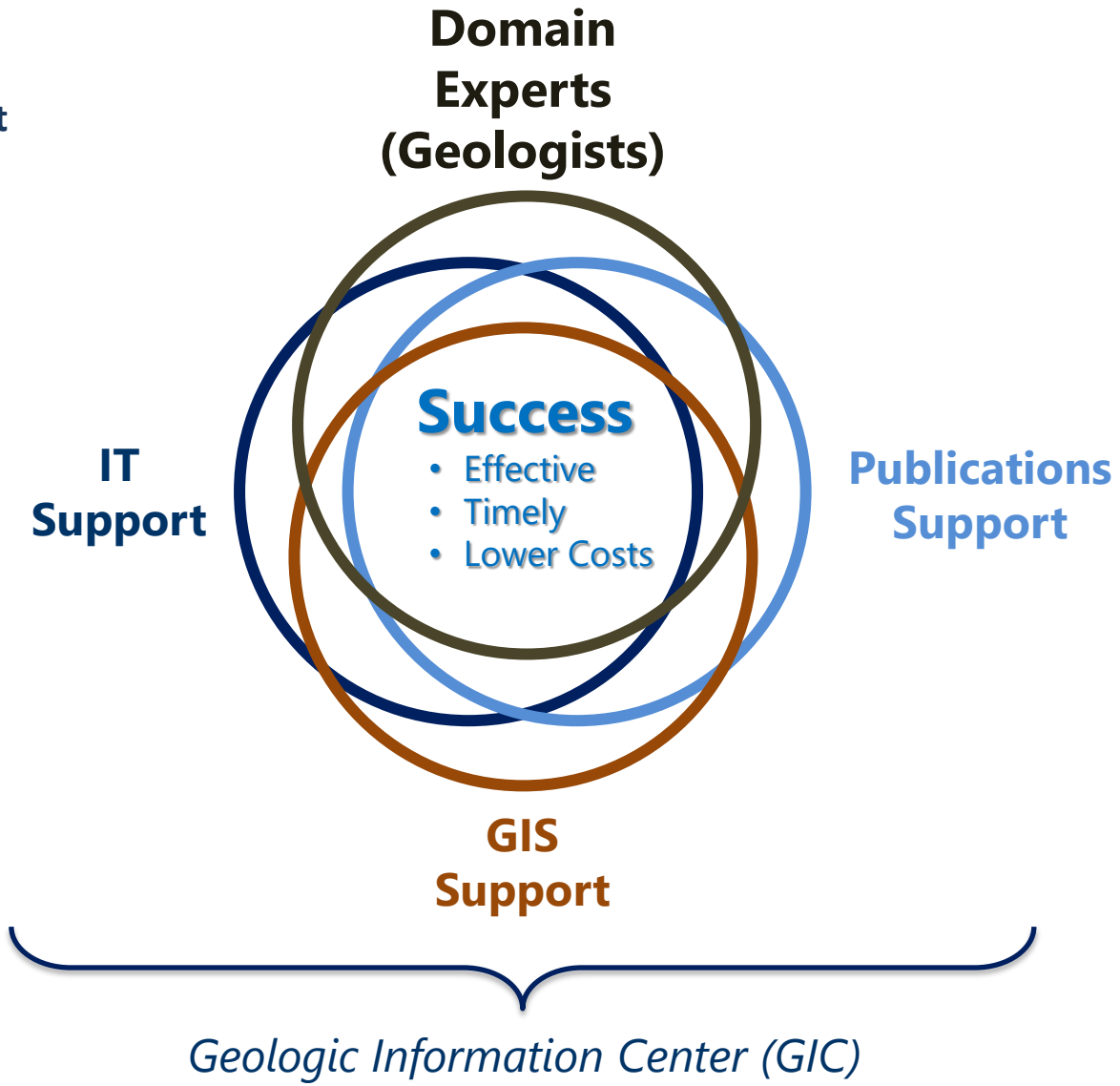


- We continue to leverage efficiencies gained from developing a formal standards-based **Alaska Geologic Mapping System** and having a formal governance body, the GEologic Data Inquiry **(GEDI) council**, which meets weekly.
- Fully integrated **version 2 of AK GeMS** Data and Symbology standards into our production process https://doi.org/10.14509/31172; https://doi.org/10.14509/31101.
- **AK GeMS Multimap Database Repository Digital Data Series (DDS).** Near completion of publishing the DDS which will provide regular geologic map file geodatabase snapshots of all currently available public geologic map database in one handy database and schema (AK GeMS).
- Updates to Production and Support Tools
- Established a Geologic Map Digitizing **Master Agreement** with our contractor, Kinney Engineering, and implemented advanced capabilities that greatly **improved efficiencies** for both parties. 14 maps digitized.

AK GeMS
Geologic Mapping System

Integrated Team Is Essential!

- **Dedicated and Embedded IT support** at the Division Level is Absolutely Critical
- **Regularly scheduled coordination meetings:**
  - Weekly GEDI meetings (Geologic Data Inquiry)
  - Bi-weekly Division Publications Meetings
  - Weekly GeMS Multimap Meetings
  - Individual Product Production Status Meetings
  - Other Spin Off Meetings
- **Emphasis on Training:**
  - Weekly GIS Tips & Tricks
  - Illustrator sessions
  - ESRI Training emphasis
  - One-on-one training and support from IT, GIS, & Publications.

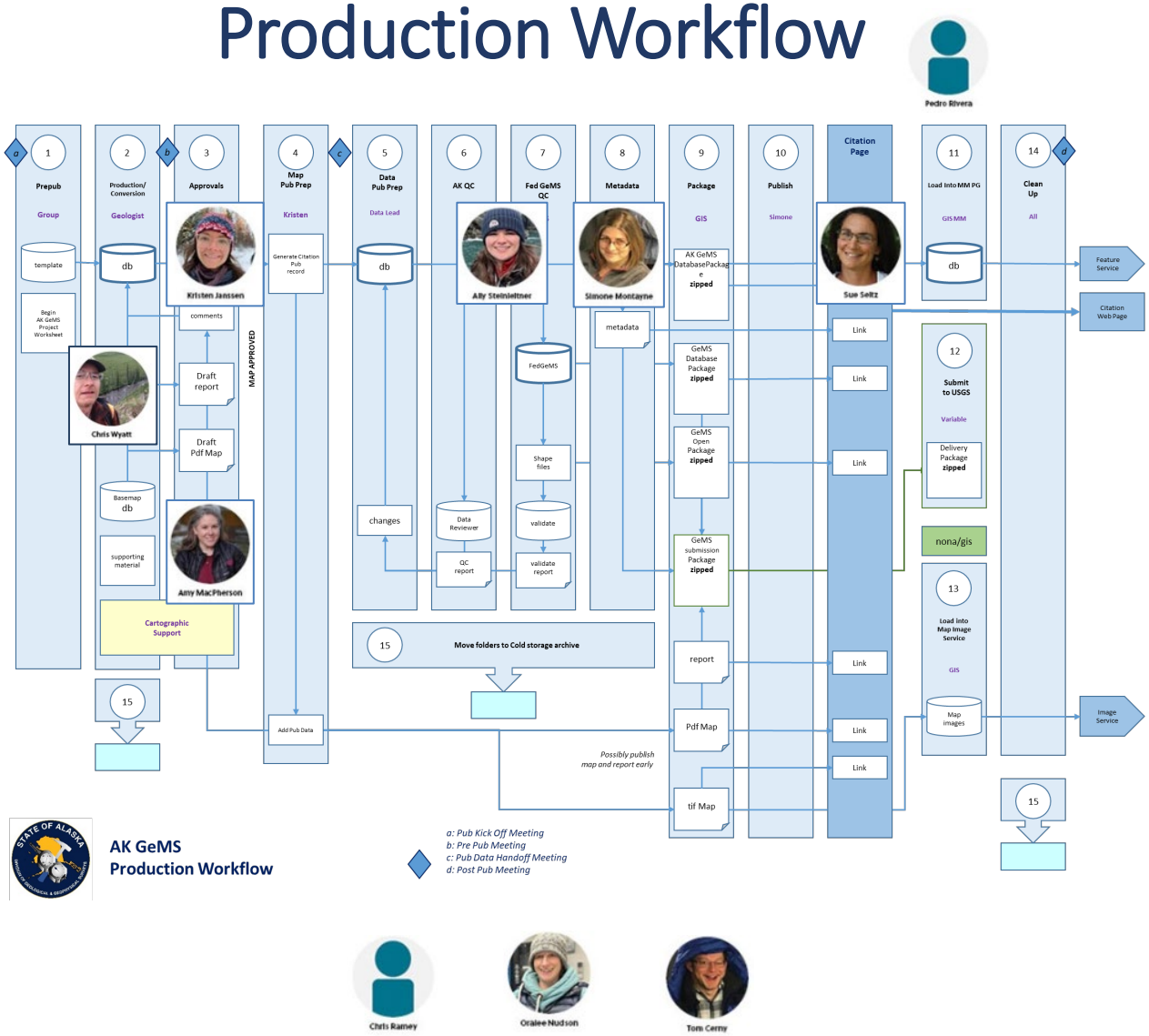


Well-defined organizational procedures are critical

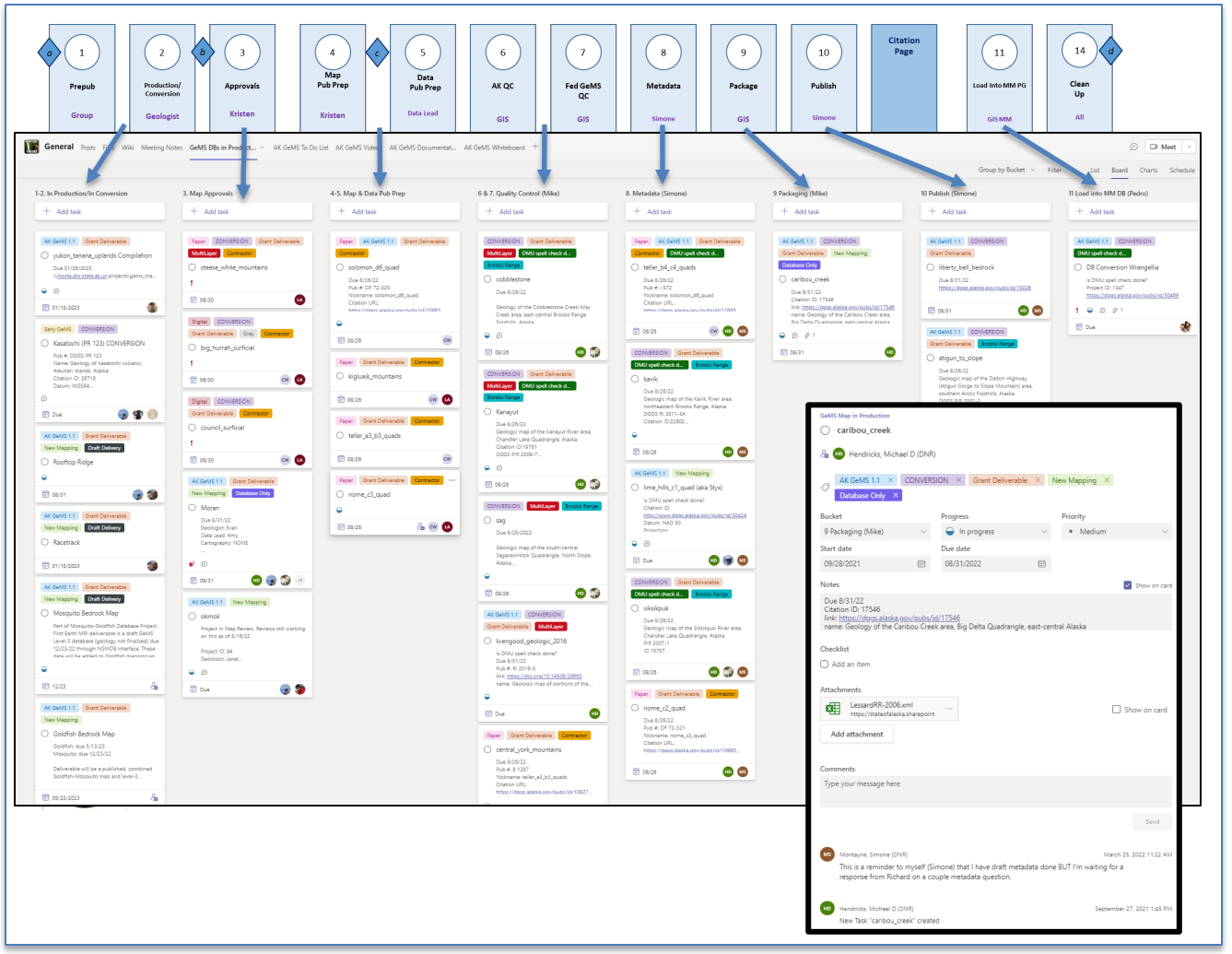
Key Aspects

- The backbone of our procedures is our **AK GeMS production workflow graphic**
- This workflow is a **16-phase process** that takes a map and its data from pre-publication though production, quality control, publication, and archiving
- The workflow identifies:
  - **Order**
  - **Responsibilities**
  - **Location of data**
  - **Production meetings**
  - **Products**

AK GeMS Production Workflow

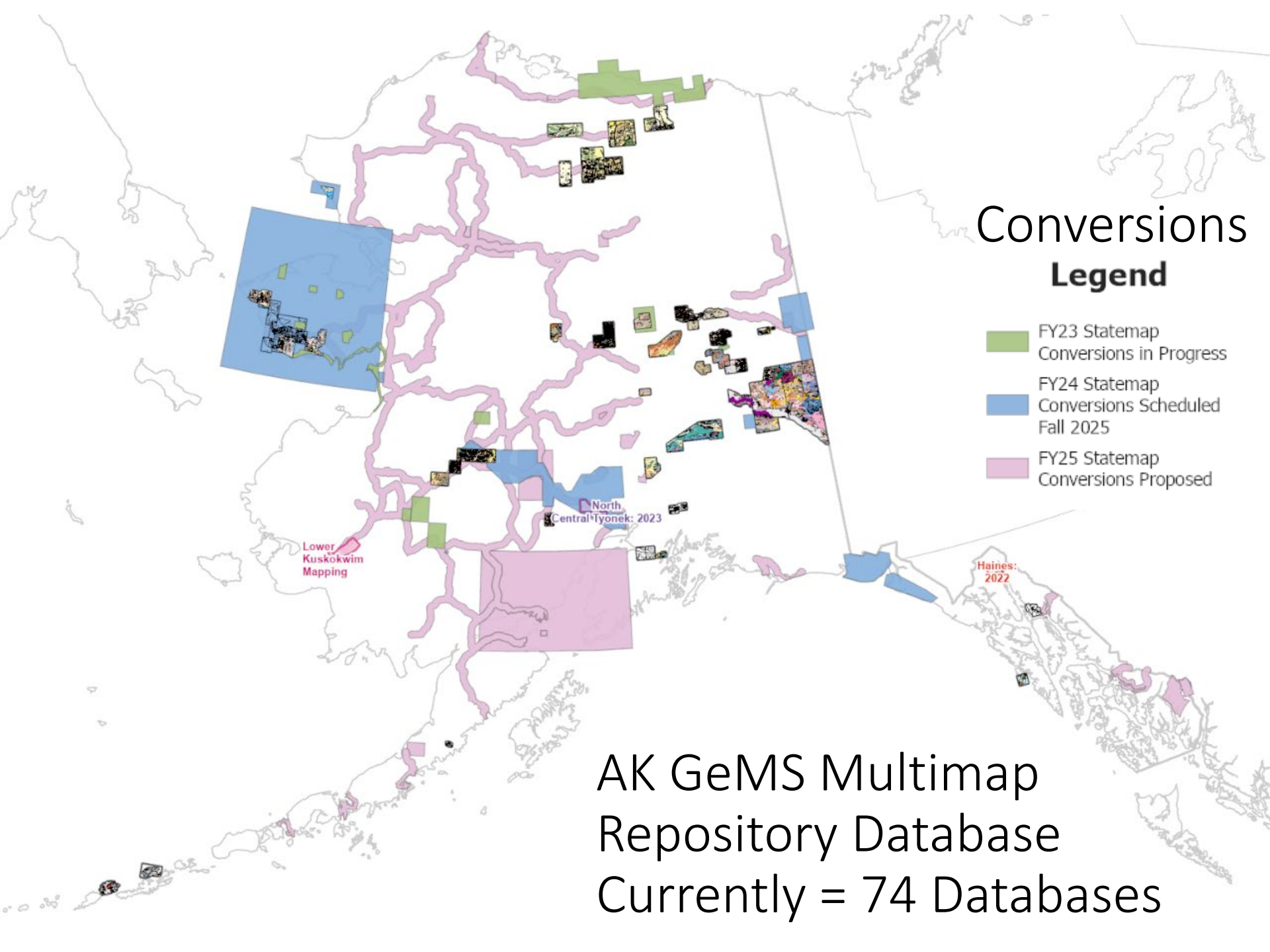


Using MS Teams **Planner App** to track map production through the AK GeMS Production Workflow



Reviewed during

- Weekly GEDI meetings (***Ge**ologic **D**ata **I**nquiry*)
- Bi-weekly Publications Productions Meetings
- Quarterly Division Leadership Publications Meetings

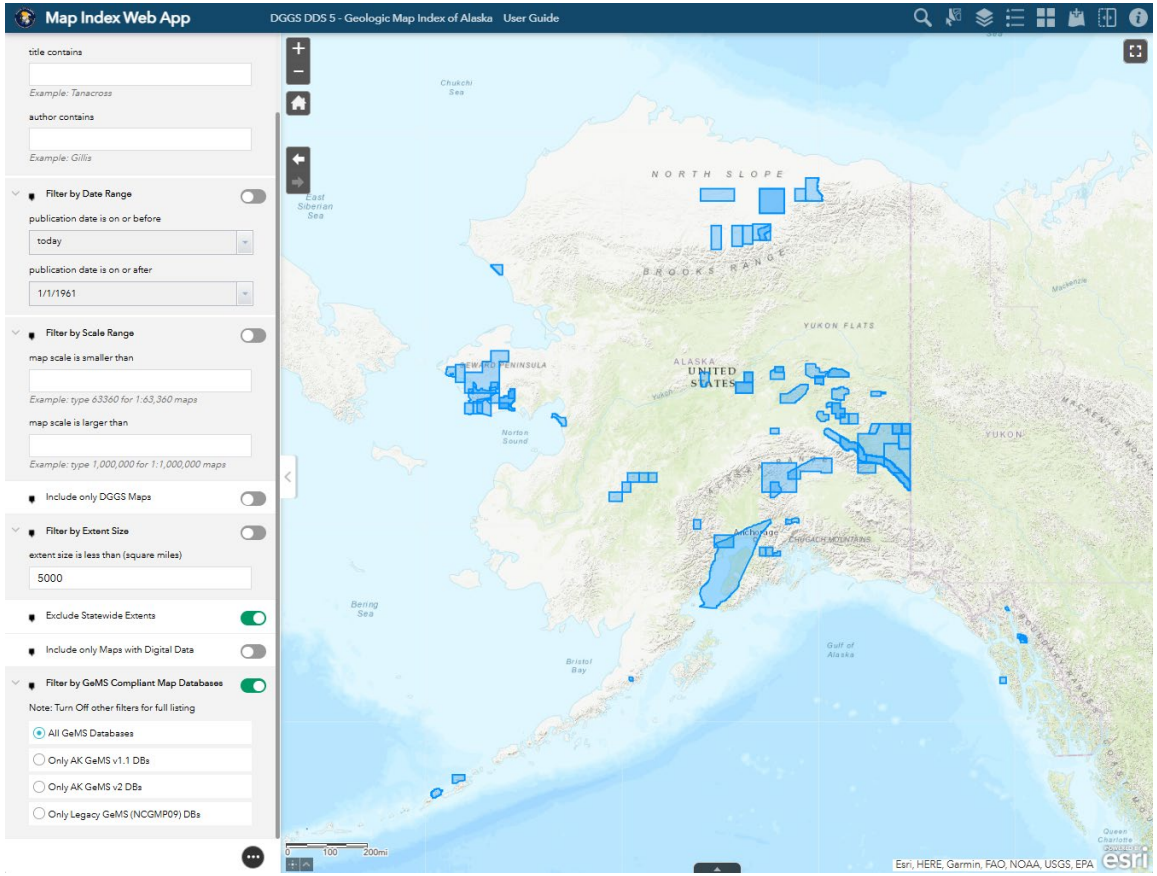

Conversions
Legend
FY23 Statemap Conversions in Progress
FY24 Statemap Conversions Scheduled Fall 2025
FY25 Statemap Conversions Proposed
North Central Tyonek: 2023
Lower Kuskokwim Mapping
Haines: 2022
AK GeMS Multimap Repository Database
Currently = 74 Databases

Geologic Map Index Web App

https://maps.dggs.alaska.gov/mapindex

AK GeMS Availability

- **Available**: 88 AK GeMS Map Database currently available for download
- **In Production**: 29 Geologic Maps currently in production
- **Planned**: We have 50+ Geologic Maps will go into production this next year



For additional Information & related Presentations and Publications

https://dggs.alaska.gov/pubs/project/1607

Geologic Map Index Web App

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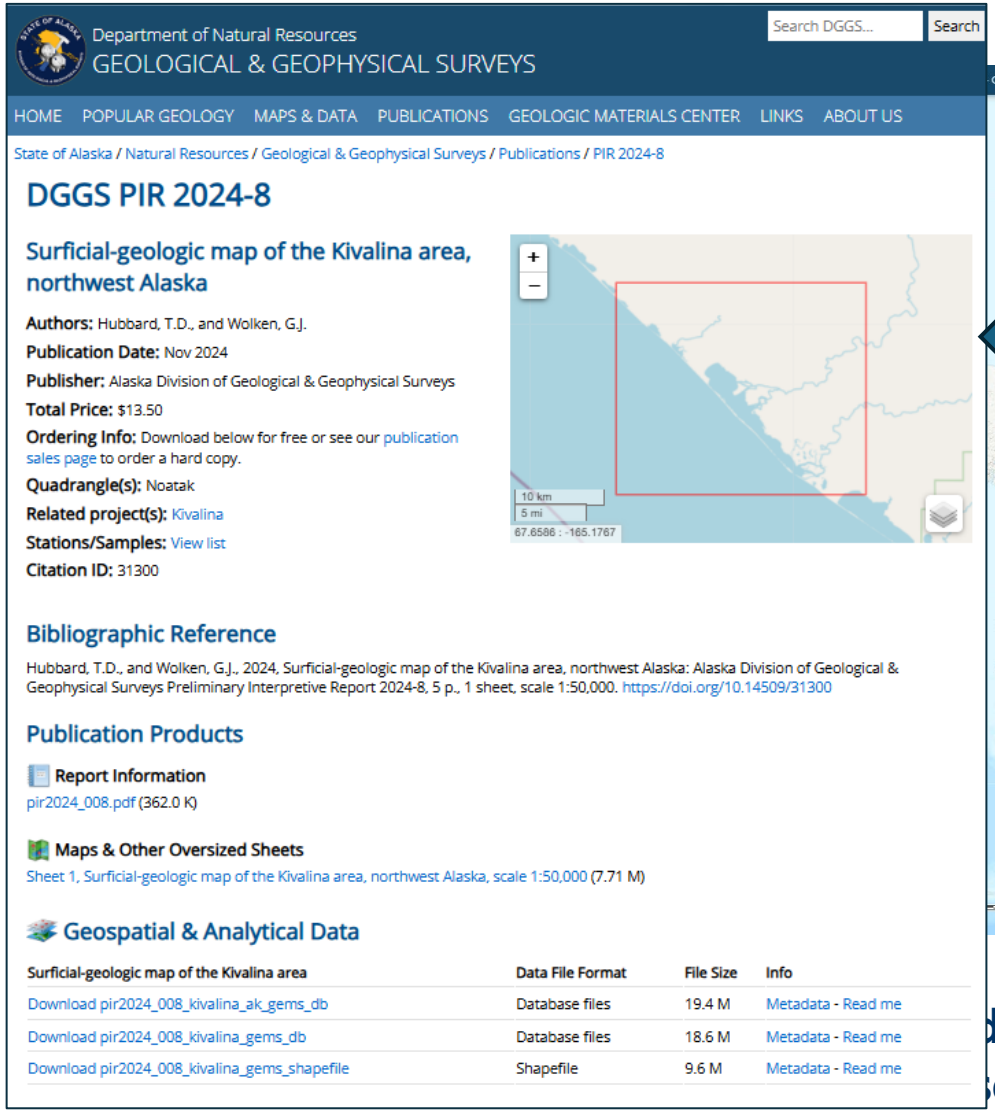

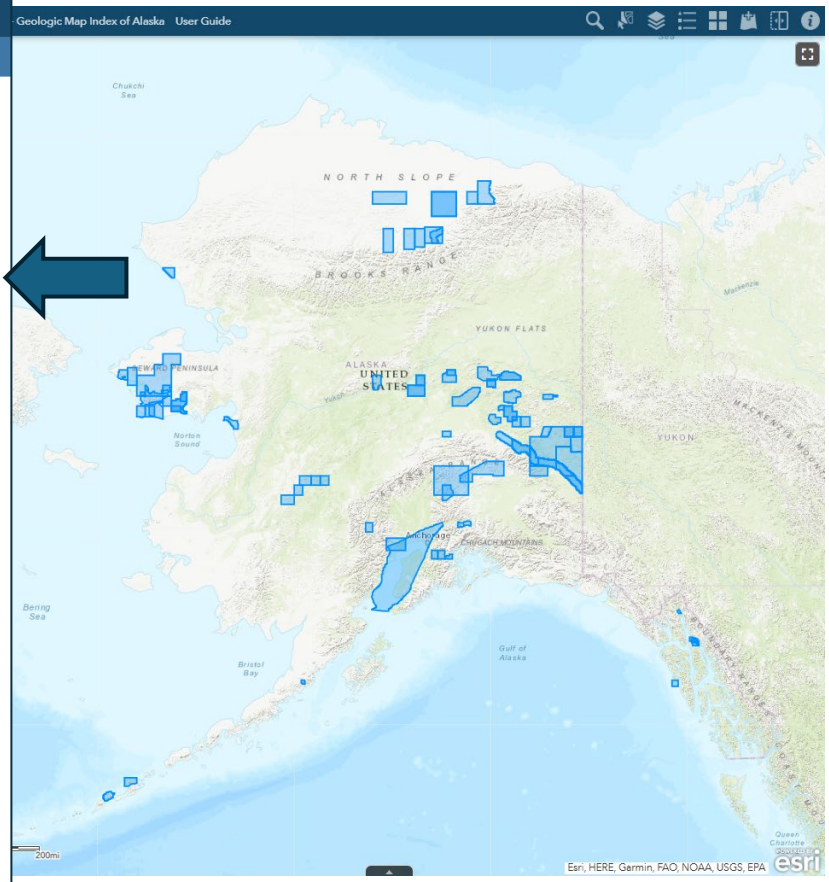

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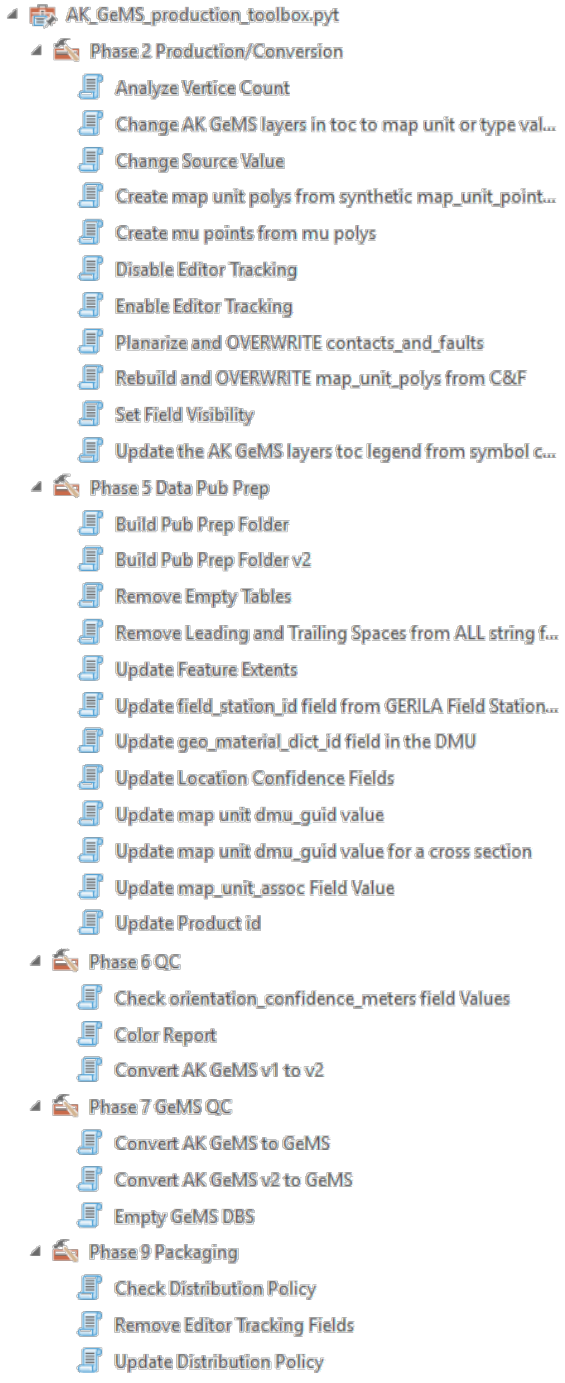


AK GeMS
Geologic Mapping System
Tool News

AK GeMS Production Toolbox

- *Changes to support AK GeMS v2 schema*
- NEW - Set Field Visibility
- NEW - Analyze Vertice Count
- NEW - Change AK GeMS layers in toc to map unit or type value
- Create map unit polys from synthetic map_unit_points and contact_and_faults
- Color QC tools

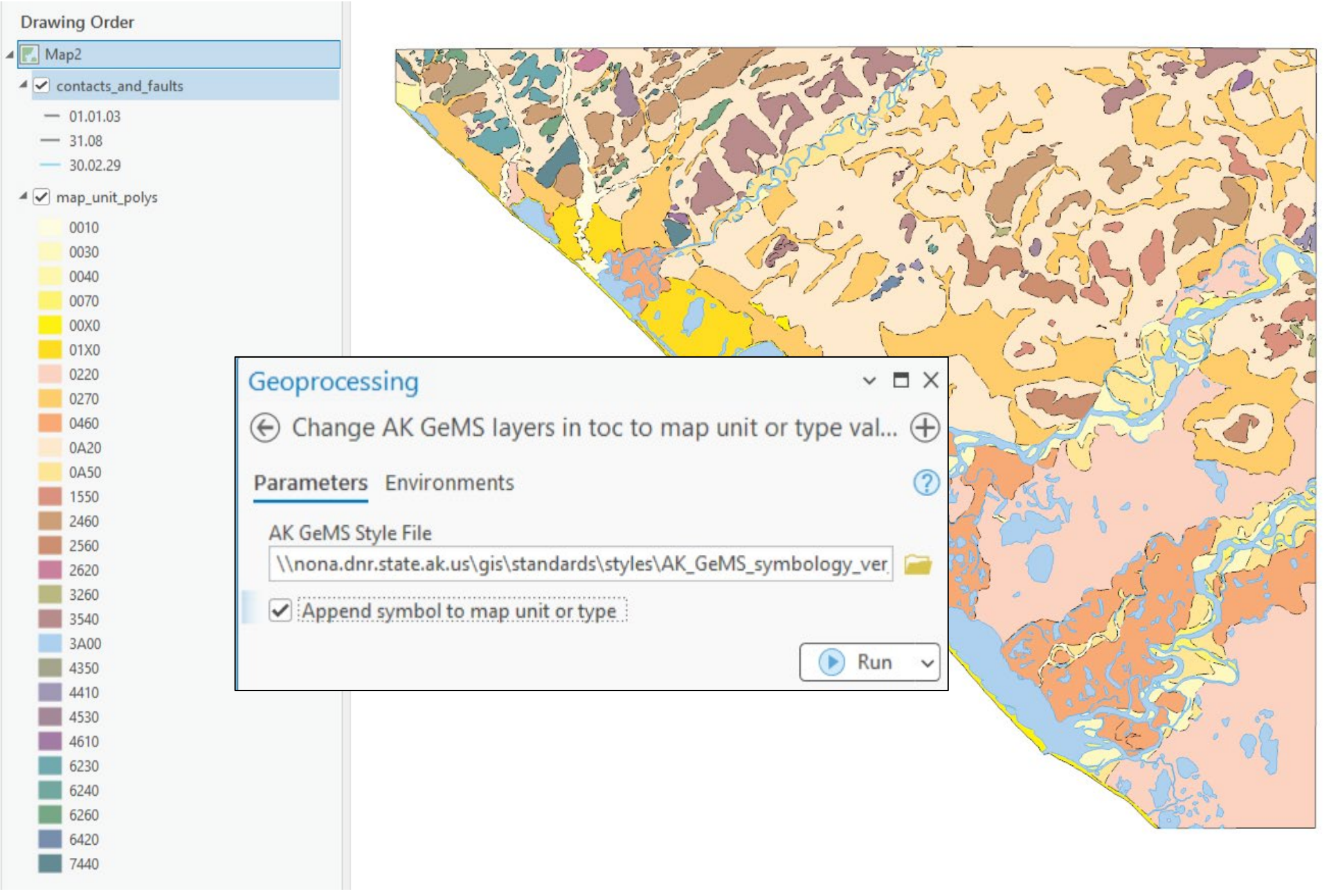
GeoMapLayout Toolbox

- Geology Map Legend Builder

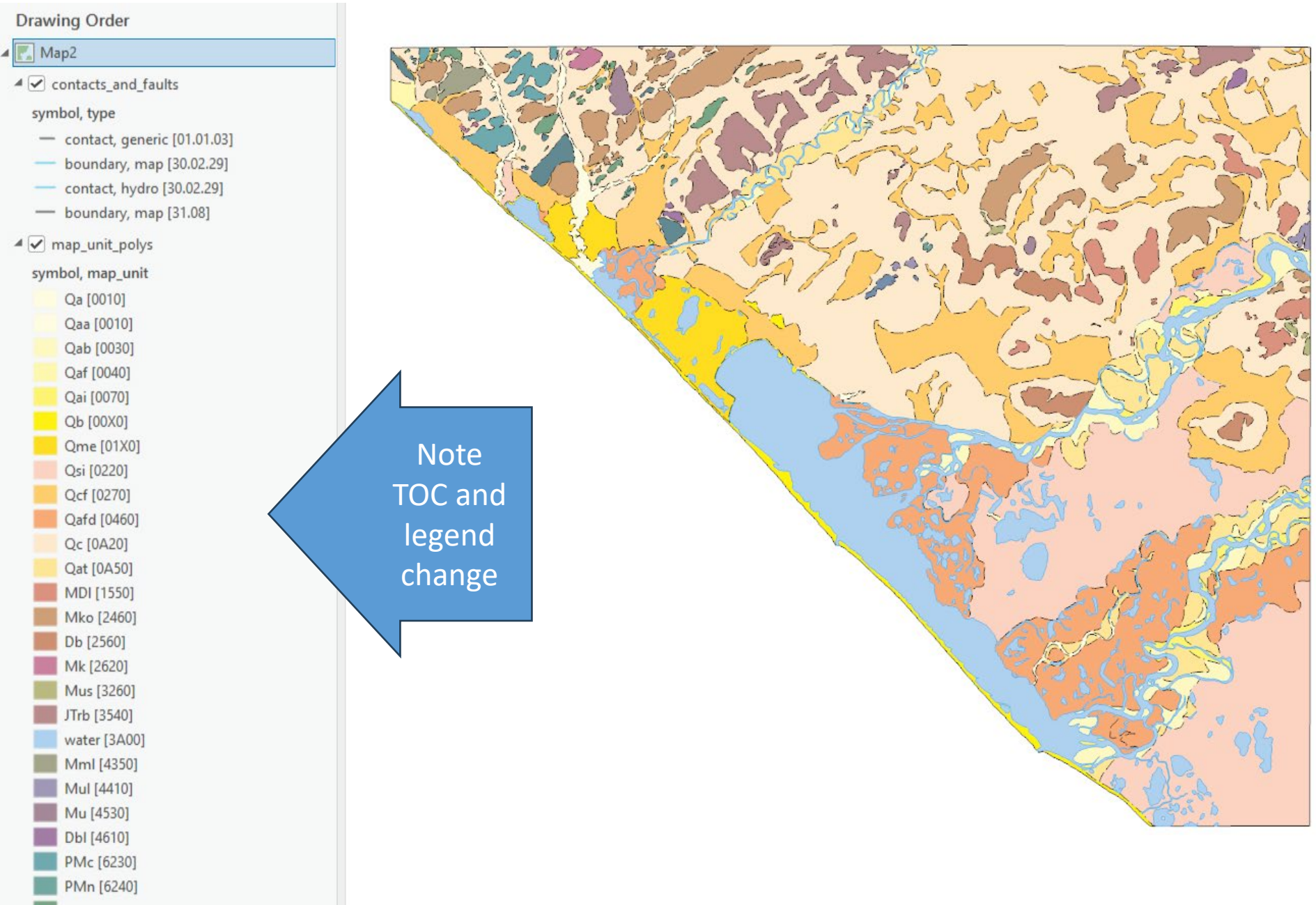
GeMS_MM_User_Tools Toolbox

- *Changes to support AK GeMS v2 schema*

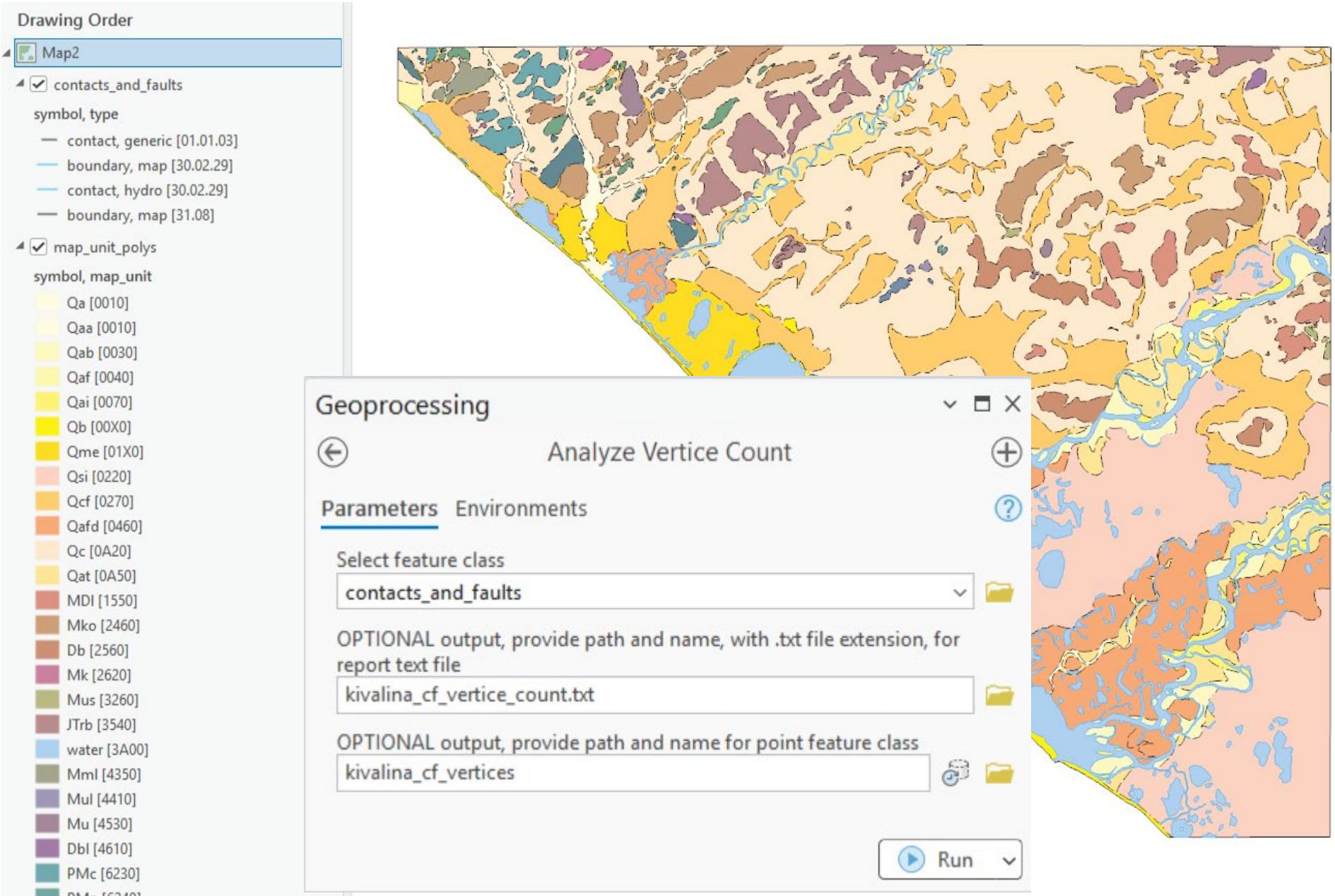
Change AK GeMS layers in toc to map unit or type



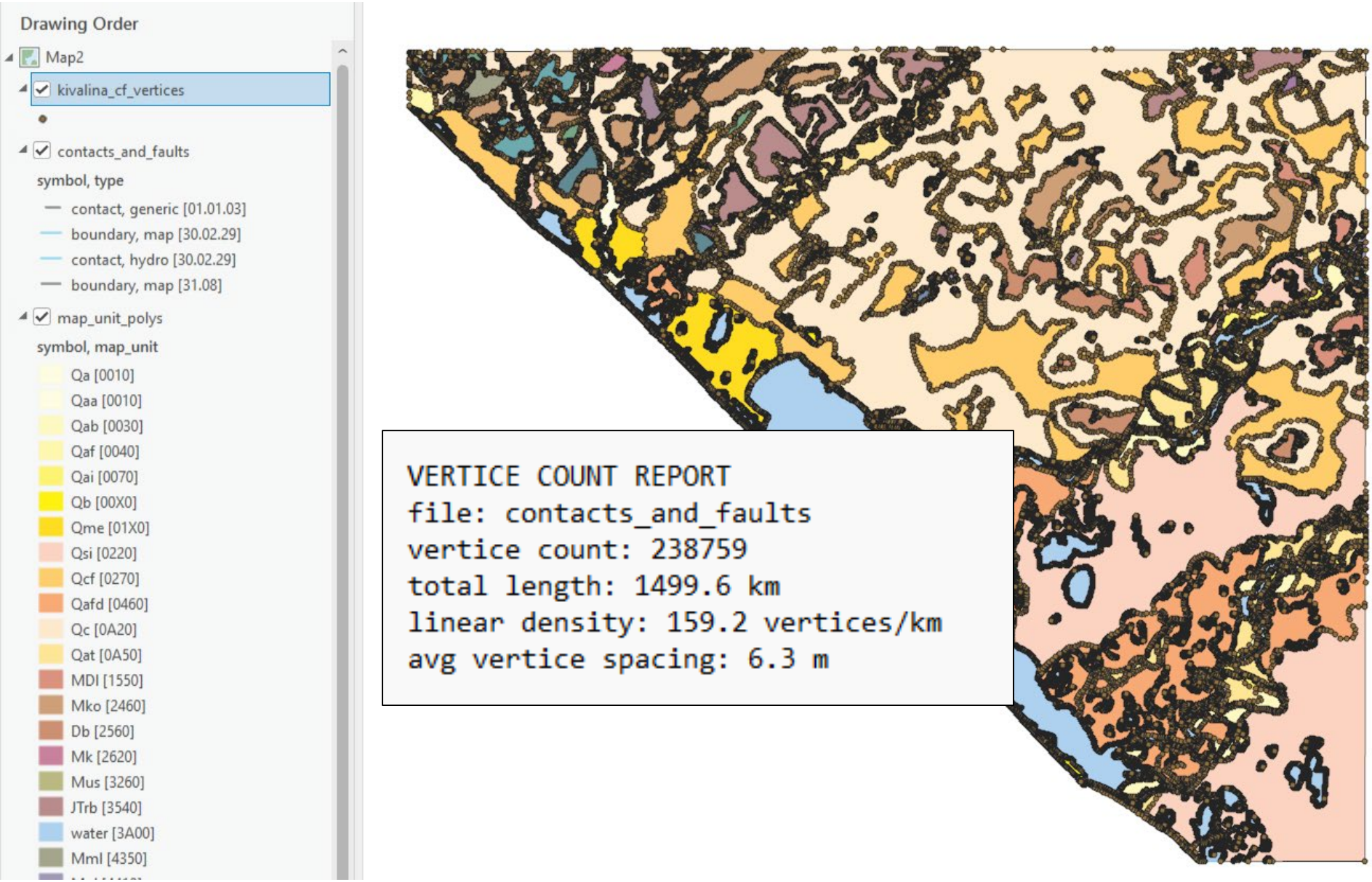
Change AK GeMS layers in toc to map unit or type



Analyze Vertice Count



Analyze Vertice Count



Set Field Visibility

map_unit_polys - Untitled - ArcGIS Pro

map_unit_polys

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	OBJECTID *	Shape *	map_unit_polys_id	symbol	type	category	layer	identity_confide...	is_concealed	draw_policy	data_sources	data_sources_m...	notes	group_id	modifier
1	1	Polygon	{15AE67CC-BD5D...	3A00	map unit, generic	map unit	1	certain	no	yes	Hubbard and othe...	Feature unmodified	Polygon outlines f...	<Null>	<Null>
2	2	Polygon	{90265FAF-7CBF-...	3A00	map unit, generic	map unit	1	certain	no	yes	Hubbard and othe...	Feature unmodified	Polygon outlines f...	<Null>	<Null>
3	3	Polygon	{7E8B011B-2F0F-...	0220	map unit, generic	map unit	1	certain	no	yes	Hubbard and othe...	New feature based p	Polygon outlines f...	<Null>	<Null>
4	4	Polygon	{B502C9EB-A5C4-...	3A00	map unit, generic	map unit	1	certain	no	yes	Hubbard and othe...	Feature unmodified	Polygon outlines f...	<Null>	<Null>
5	5	Polygon	{FE1E26F3-533D-...	3A00	map unit, generic	map unit	1	certain	no	yes	Hubbard and othe...	Feature unmodified	Polygon outlines f...	<Null>	<Null>

0 of 655 selected Filters: 100%

Hides fields not required during early production

map_unit_polys - Untitled - ArcGIS Pro

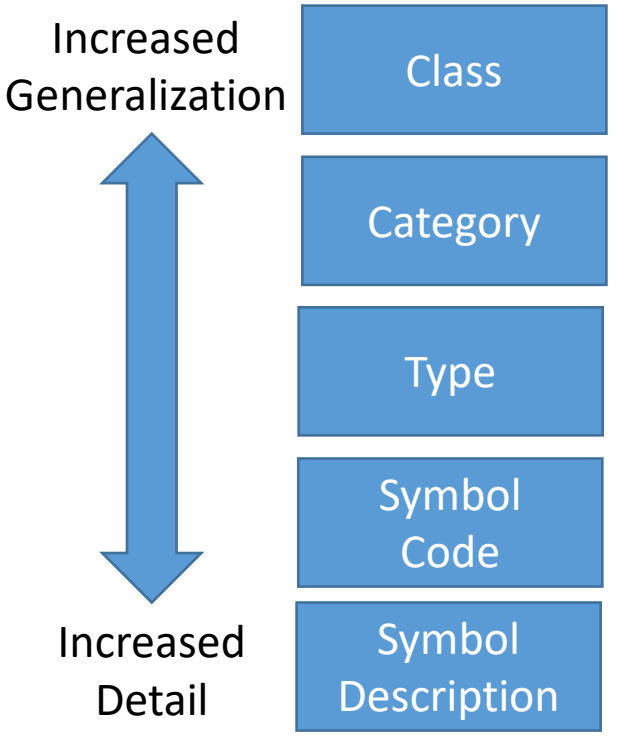
map_unit_polys

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	Shape *	symbol	type	layer	identity_confide...	is_concealed	draw_policy	data_sources_m...	notes	product_id	map_unit	label	Shape_Length	Shape_Area
1	Polygon	3A00	map unit, generic	1	certain	no	yes	Feature unmodified	Polygon outlines f...	{093ED6B1-3D9A-4709-9D65-432FD0B5EDCB}	water	<Null>	422.336461	10232.31884
2	Polygon	3A00	map unit, generic	1	certain	no	yes	Feature unmodified	Polygon outlines f...	{093ED6B1-3D9A-4709-9D65-432FD0B5EDCB}	water	<Null>	1334.102011	34509.71033
3	Polygon	0220	map unit, generic	1	certain	no	yes	New feature based p	Polygon outlines f...	{093ED6B1-3D9A-4709-9D65-432FD0B5EDCB}	Qsi	Qsi	387.467602	8749.60426
4	Polygon	3A00	map unit, generic	1	certain	no	yes	Feature unmodified	Polygon outlines f...	{093ED6B1-3D9A-4709-9D65-432FD0B5EDCB}	water	<Null>	597.15031	15542.88527
5	Polygon	3A00	map unit, generic	1	certain	no	yes	Feature unmodified	Polygon outlines f...	{093ED6B1-3D9A-4709-9D65-432FD0B5EDCB}	water	<Null>	738.508939	23523.08995

0 of 655 selected Filters: 100%

Symbols and symbol_info table



With the addition of a **symbol_info table** we now have the capability to:

- Improve popup detail & provide users with symbol descriptions
- Automate QC of symbology code usage

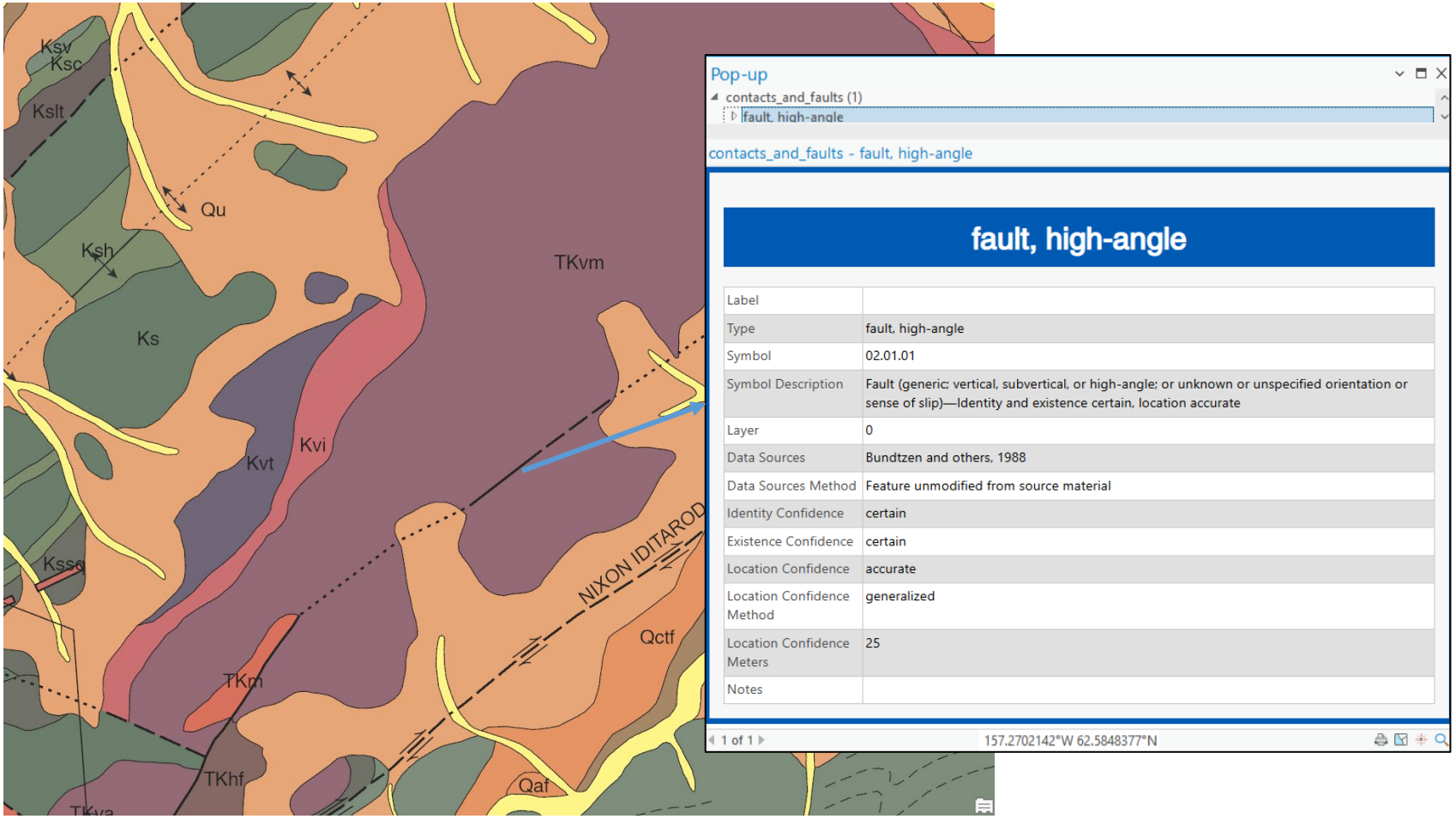
symbol_info

Field: Add Calculate | Selection: Select By Attributes Zoom To Switch Clear Delete Copy | Rows: Insert

	symbol *	symbol_description	assoc_symbol_c...	feature_class	feature_class_cat	feature_class_type	notes	rotation_reqd	inclination_reqd
1	01.01.01	Contact—Identity and existence certain, location accurate	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>
2	01.01.02	Contact—Identity or existence questionable, location accur...	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>
3	01.01.03	Contact—Identity and existence certain, location approxim...	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>
4	01.01.04	Contact—Identity or existence questionable, location appro...	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>
5	01.01.05	Contact—Identity and existence certain, location inferred	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>
6	01.01.06	Contact—Identity or existence questionable, location inferr...	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>
7	01.01.07	Contact—Identity and existence certain, location concealed	<Null>	contacts_and_faults	contact	contact, generic	<Null>	<Null>	<Null>

1,263 records

Symbols and symbol_info table



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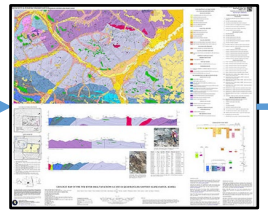
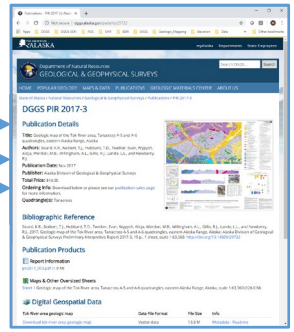


Geologic Map Image Services

Product Web Page



Export

Alaska DGGS Single Map AK GeMS Geodatabase

Convert

USGS Single Map GeMS Geodatabase

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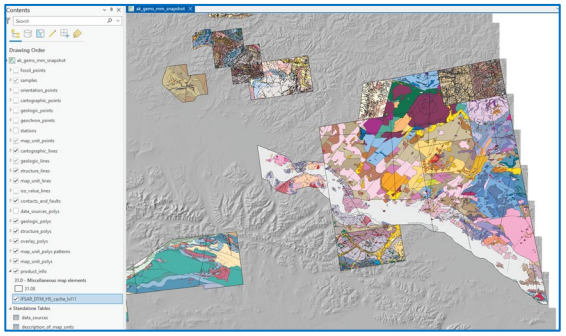
Alaska DGGS Multi-Map Ver 2.0 GeMS DB Basic Architecture



(DEV)

AK GeMS MultiMap DB
(PostgreSQL)
ak_gems_mm_ver2_dev

Internal users

(STAGING)

Bulk Load of **SINGLE** geologic map dataset

(PRODUCTION)

AK GeMS MultiMap DB
(PostgreSQL)
ak_gems_mm_ver2_prod

Filter
Public only

Filtered MultiMap Schema FileGDB

Public Web Services

Individual **MultiMap V2 Schema** FileGDB

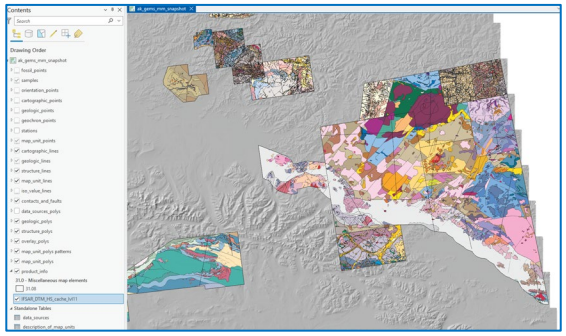
Convert

Individual **SingleMap V2 Schema** FileGDB

The key differences from the AK GeMS single-map schema are as follows:

- The AK GeMS multi-map database is **an Enterprise PostgreSQL Geodatabase** hosted in a Linux environment.
- Attribute fields with **defined attribute domains are integer-based** to decrease storage and improve performance.
- The ID fields for each feature class and standalone table are **true GUID type fields**, as opposed to the AK GeMS single-map's string-based approach of using GUIDs.

Alaska DGGS Multi-Map Ver 2.0 GeMS DB Basic Architecture



(DEV)

AK GeMS MultiMap DB (PostgreSQL)
ak_gems_mm_ver2_dev

Internal users

(STAGING)

Individual **MultiMap V2 Schema** FileGDB

Bulk Load of **SINGLE** geologic map dataset

(PRODUCTION)

AK GeMS MultiMap DB (PostgreSQL)
ak_gems_mm_ver2_prod

Filter
Public only

Simplify

Filtered MultiMap Schema FileGDB

Public Web Services

Still challenges with:
- Symbology
- Labels

Convert

Individual **SingleMap V2 Schema** FileGDB

Copy

DDS-X

Database package

MultiMap Schema FileGDB

.mapx

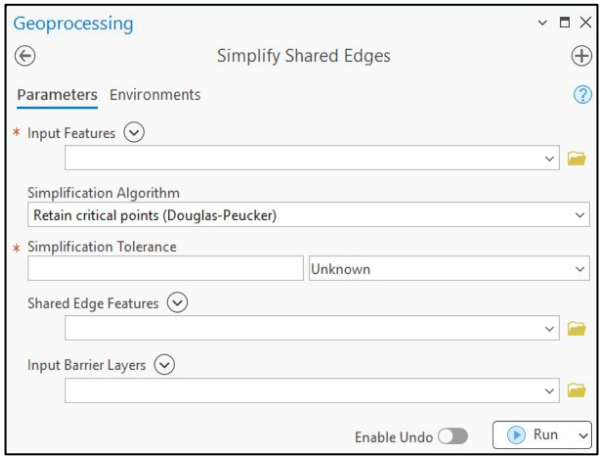
The key differences from the AK GeMS single-map schema are as follows:

- The AK GeMS multi-map database is **an Enterprise PostgreSQL Geodatabase** hosted in a Linux environment.
- Attribute fields with **defined attribute domains are integer-based** to decrease storage and improve performance.
- The ID fields for each feature class and standalone table are **true GUID type fields**, as opposed to the AK GeMS single-map's string-based approach of using GUIDs.

Simplification testing

Testing Simplify Shared Edges Tool

Simplifies the edges of input features while maintaining the topological relationship with edges shared with other features.



Given: File Geodatabase

Contacts_and _faults with 2,348,855 vertices

Simplification Tolerance	Retain critical points	Retain critical bends	Retain weighted effective area	Retain effective areas
10m	827,303	2,110,354	2,085229	1,448,149
20m	588,469	2,032,975	1,981,160	1,051,049
40m	422,122	~1,800,000	1,733,826	688,980

Multimap Database Statistics

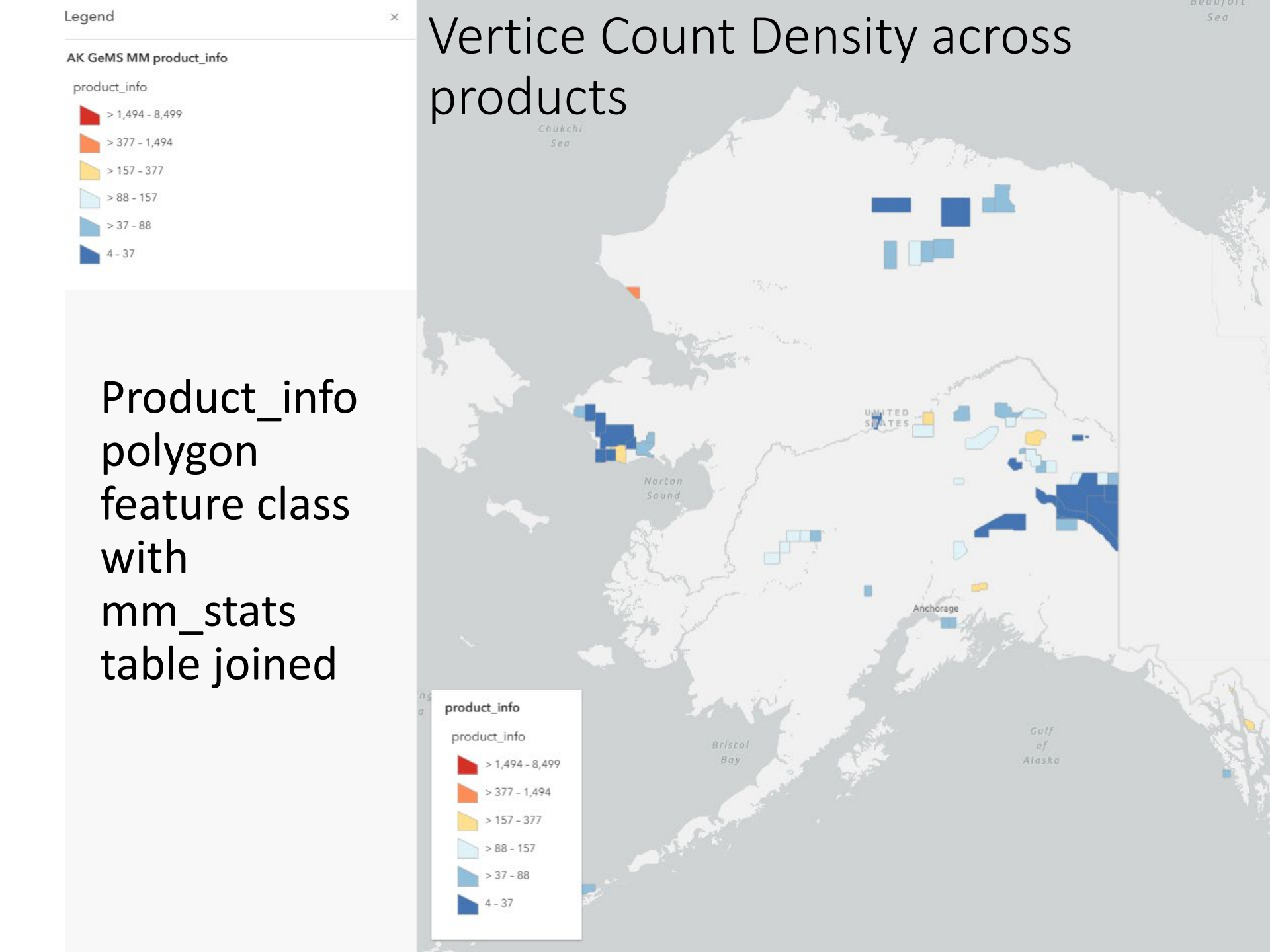
ak_gems_mm_ver2_prod.gems.mm_stats

Field: Add Calculate | Selection: Select By Attributes Switch Clear Delete Copy | Rows: Insert

	nickname	square_miles	vertice_count_density	vertice_count_cf	total_features	num_tables	contacts_and_faults	map_unit_points	map_unit_polys	orientation_points
1	iditarod_d2_d3_quads	365.38135	118.238109	43202	2603	12	1550	<Null>	588	330
2	seward_d6_quad_surficial	219.216656	55.597965	12188	1286	6	786	<Null>	302	40
3	iditarod_b4_b5_quads	418.040135	96.426148	40310	3721	12	2309	<Null>	839	138
4	talkeetna_mtns_c4_quad	451.180418	144.751406	65309	11400	13	5273	<Null>	2323	1196
5	seward_d7_quad_surficial	219.203997	59.770808	13102	1383	5	879	<Null>	351	53
6	mcgrath_d6_quad	273.788016	65.598196	17960	653	9	423	<Null>	157	41
7	kechumstuk_fault_zone	228.561721	117.193727	26786	2869	8	1933	<Null>	762	98
8	casadepaga_surficial	595.666296	107.16235	63833	5920	5	3883	<Null>	1455	<Null>
9	iditarod_d1_quad	273.622006	104.030375	28465	1847	11	1075	<Null>	405	223
10	kavik	632.477387	46.041172	29120	2173	9	1128	<Null>	478	233
11	kivalina	160.700511	1494.662328	240193	3283	11	1434	188	655	33
12	w_tanacross_and_taylor_mnt	2615.385801	4.546174	11890	5943	12	1072	<Null>	385	875

More

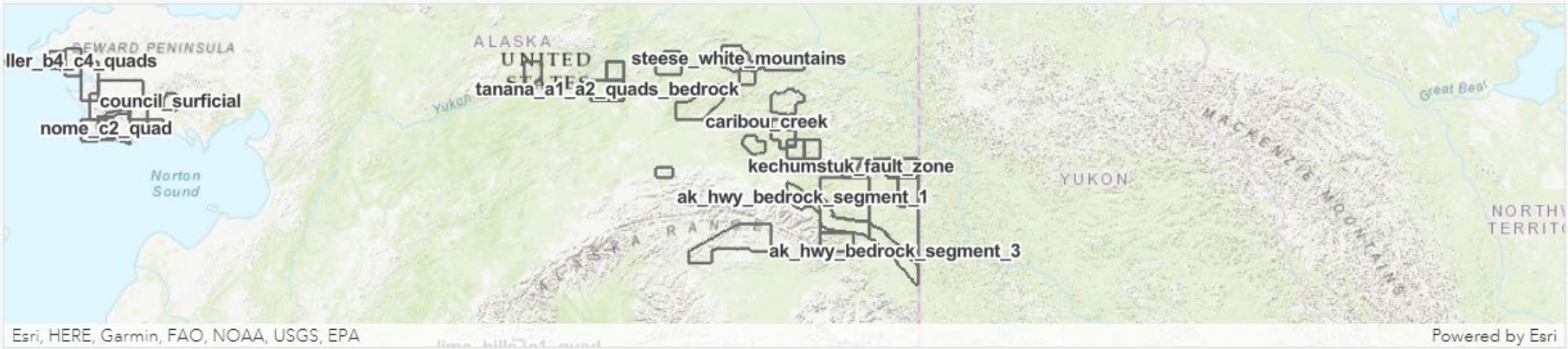
Vertice Count Density across products

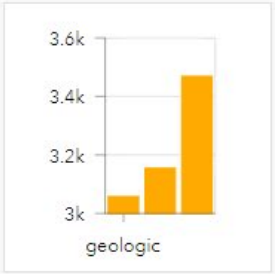


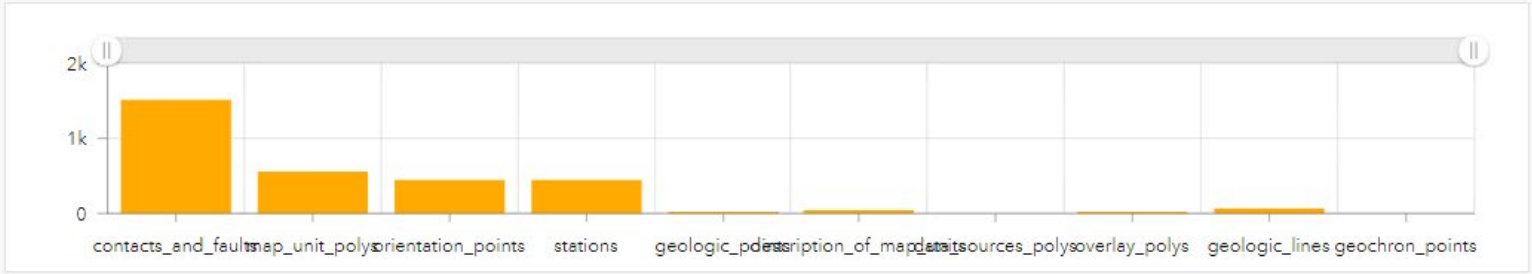
Product_info polygon feature class with mm_stats table joined

AK GeMS MM Product Web App Dashboard

Alaska DGGS
akdggs





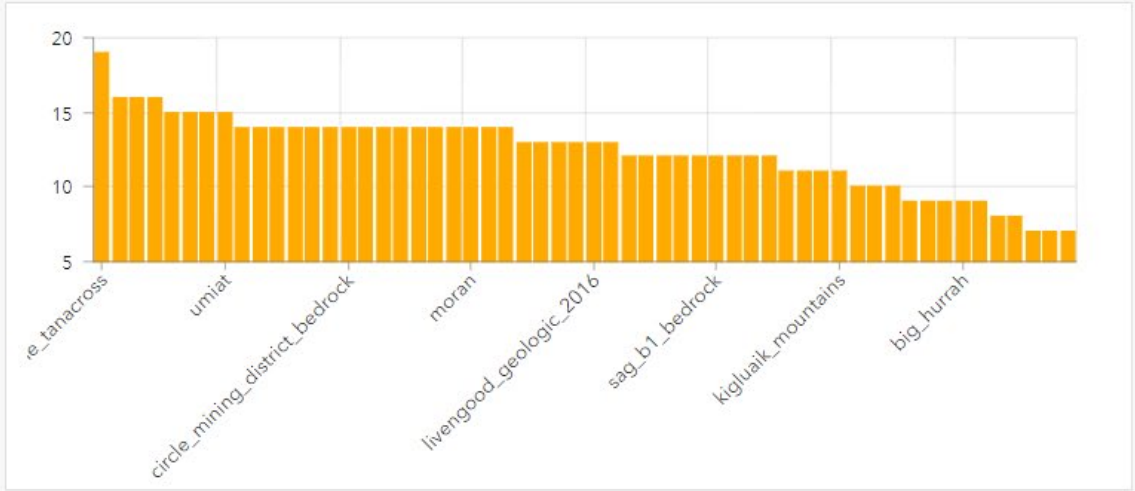


Number of AK GeMS MM Databases

56

Number of AK GeMS Multi-Map Database

52



Future work

- Improve Public and internal access to a multi-map database (in progress).
- Dashboard to display operational multi-map database statistics to increase management awareness and monitoring (in progress).
- Develop and implement web friendly symbolization for geologic map feature services and map services (in progress). Continue Experimenting with Data Dictionary Render.
- Fully leverage ArcGIS Pro's ability to embed QA checks into the schema (in progress).
- Improve support for 3D data.