DIGITAL MAPPING TECHNIQUES 2024

The following was presented at DMT '24
May 13 - 16, 2024

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2024)
http://ngmdb.usgs.gov/info/dmt/

Integration of Surficial Mapping Protocols (SUMP) with GeMS to standardize mapping from inception to final map product

By Karl Backhaus (New York Geological Survey)

At the NYSGS, a set of Surficial Mapping Protocols (SuMP) was enacted to define and establish rules for mapping in order to ensure consistency in data collection, mapping strategies, and map development. This set of standards was designed to complement GeMS, and the concurrent implementation of each streamlines the mapping process from the field map and notebook (SuMP) to the digital map and geodatabase (GeMS).

Integration of Surficial Mapping Protocols (SuMP) with GeMS to standardize mapping from inception to final map product

Karl J. Backhaus

Museum Scientist 1/Quaternary Research and Mapping Geologist

GeMS Coordinator

New York State Museum - Geological Survey

What is the New York State Geological Survey?

New York State Education Department

New York State Office of Cultural Education AKA NYS Museum

NYS Museum
New York State Museum

Research and Collections Division

NEW YORK STATE GEOLOGICAL SURVEY
Est. 1836
NEW YORK STATE MUSEUM

2024 NYSM - GS Mapping Program Staff

Karl Backhaus
Quaternary Geologic Mapping/GIS Specialist

Dr. Andrew Kozlowski
Director
Curator QLM

Dr. Andrew Clift
Sed/ Structural Mapping
Curator of Bedrock Core

Dr. Joseph Gonzales
Hard Rock Mapping
Curator of Minerals/Gems

Hailey Forgeng
Mineralogy/Petrology
Hard Rock Mapping

Julia Rogerson
GIS - Minerals Mapping

Richard Frieman
Geologic Mapping
Bedrock Core
Collection Manager

Avery Blake
GIS - Minerals Mapping

Sean Grassing
- Assistant Geologist

STATEMAP

GLGMC

EarthMRI

History of Mapping at the NYSGS

Began on April 15th,1836 with the four chief Geologists horsemen:

Eastern Region – William W. Mather

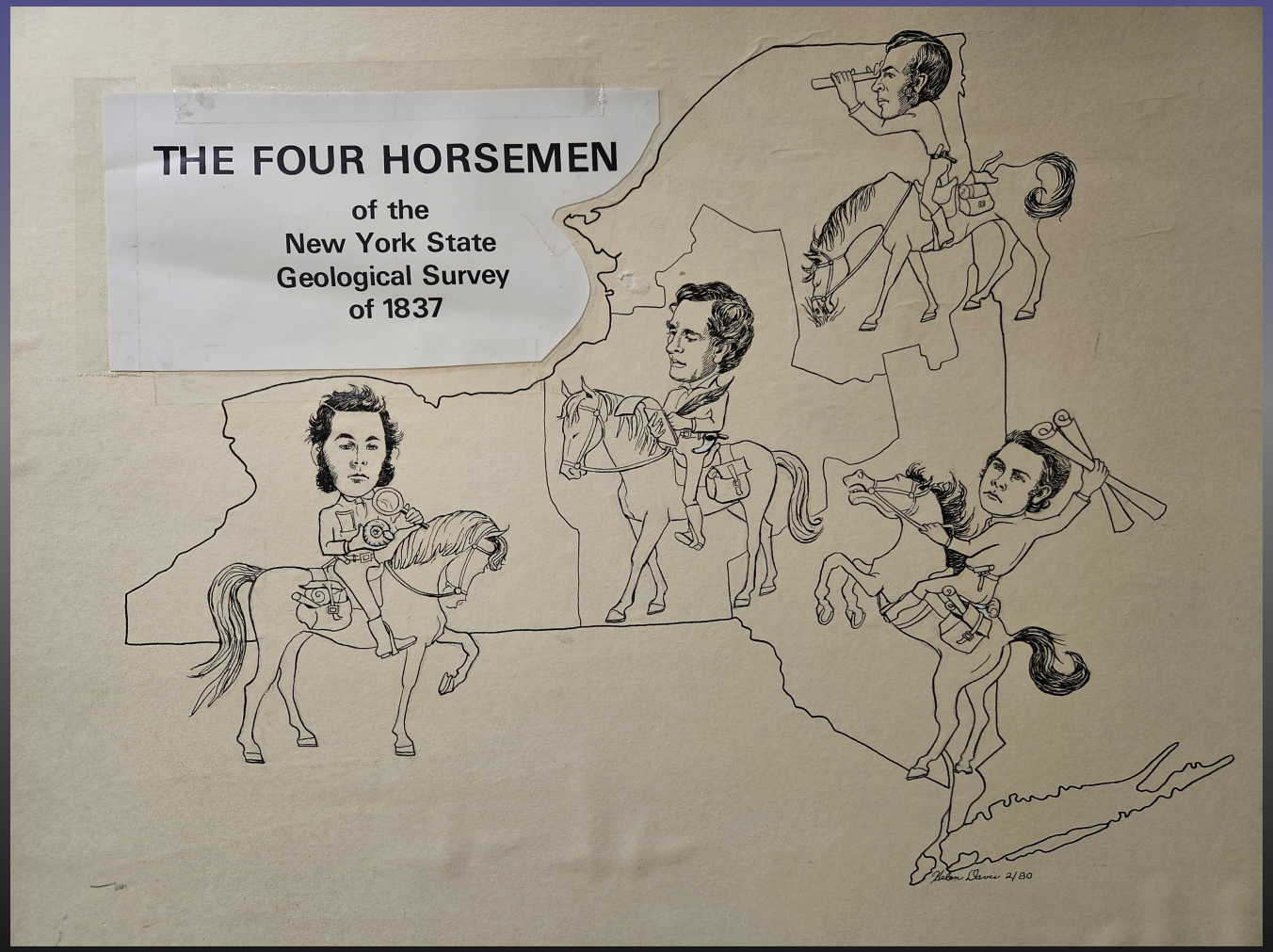
Northern Region – Ebenezer Emmons

Central Region – Timothy Conrad <- Replaced by L. Vanuxem

Western Region – Lardner Vanuxem <- Replace by J. Hall

At the time the New York Geological and Natural History survey was looking for……

COAL!

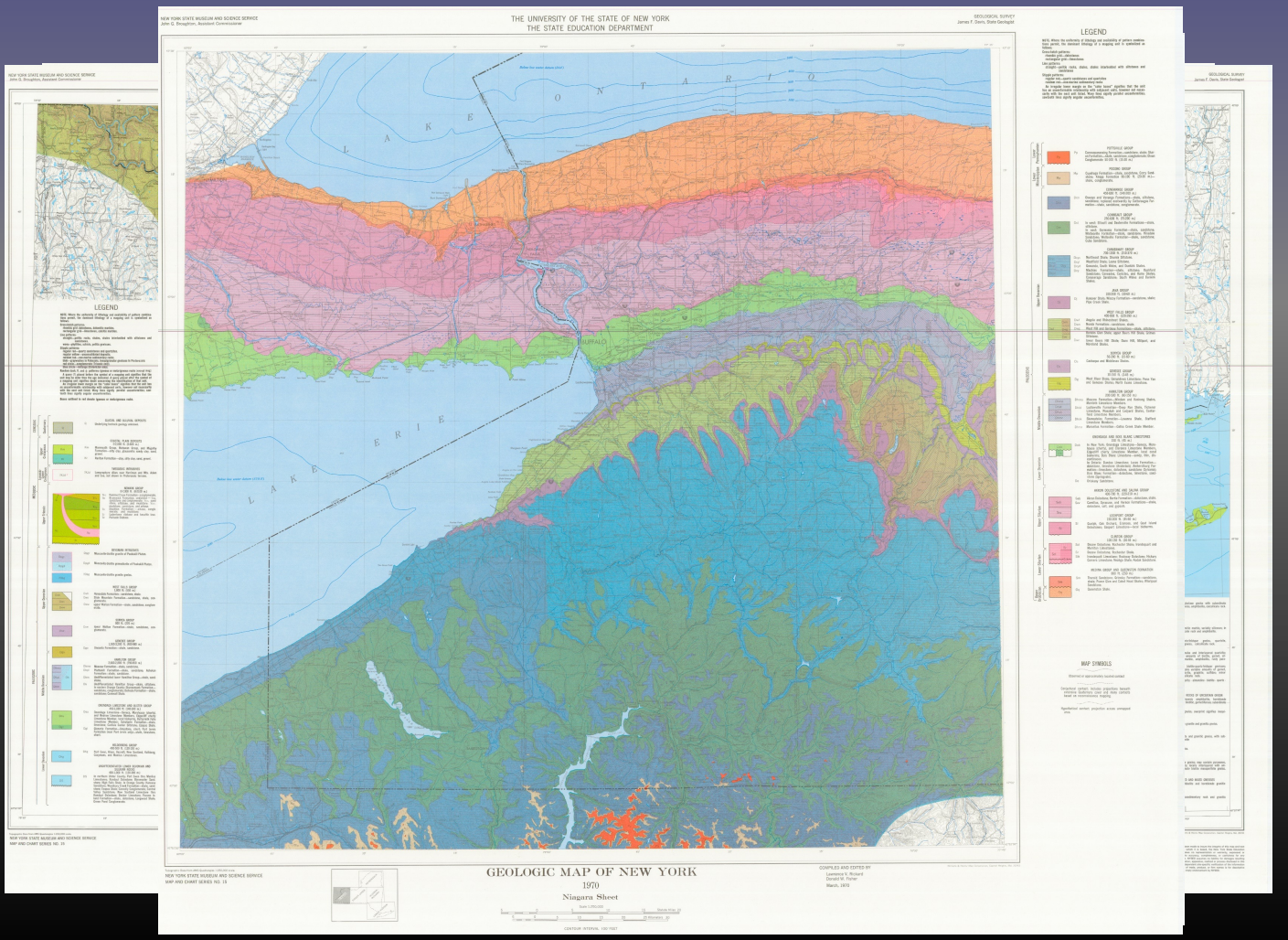


Map and Chart Series No. 15

Geologic Map of New York State

Published in five sheets in 1970

Adirondacks
Hudson-Mohawk
Lower Hudson
Finger Lakes
Niagara

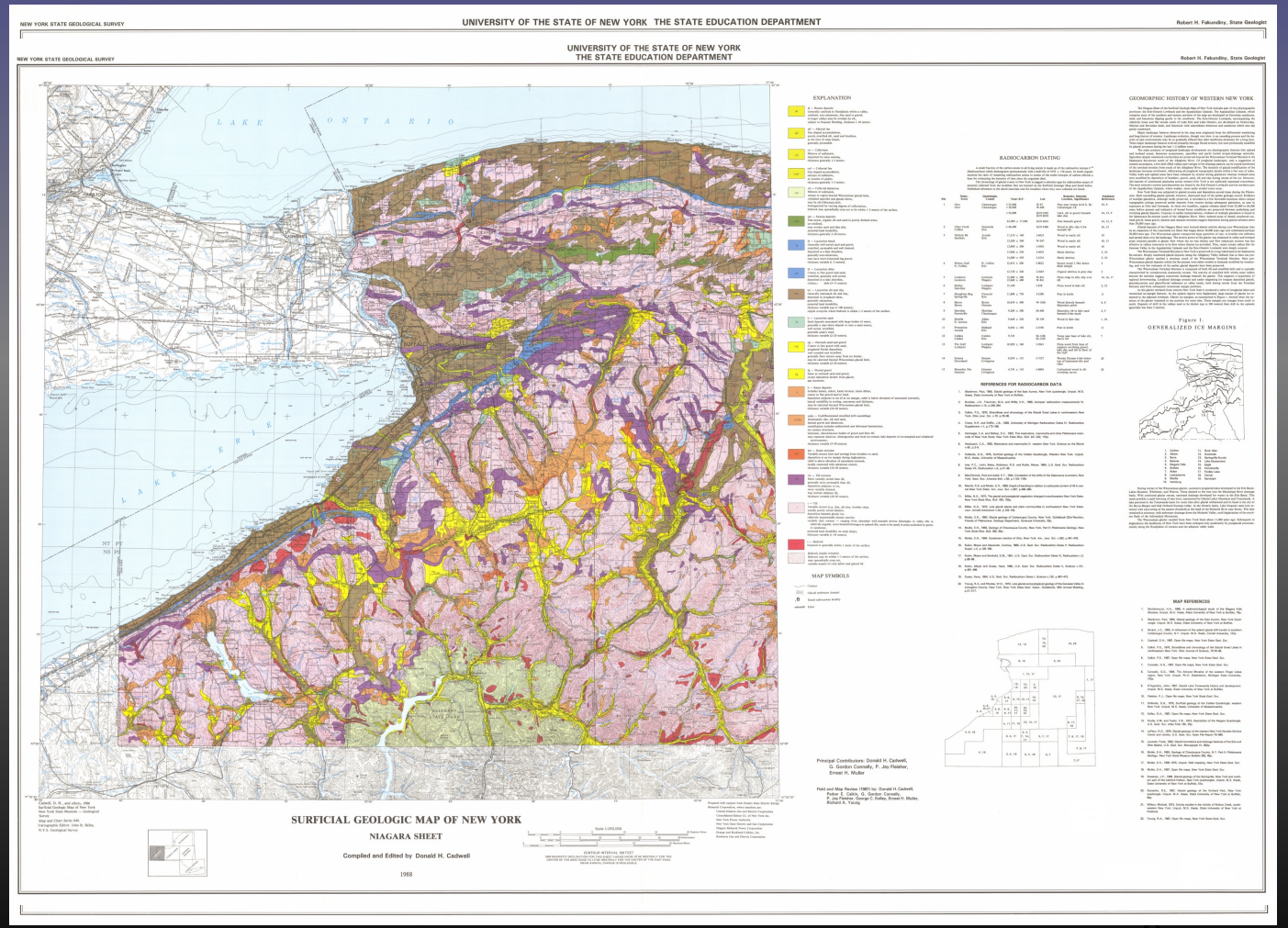


Map and Chart Series No. 40

Surficial Geologic Map of New York State

Published in five sheets from 1986 to 1991

Adirondacks
Hudson-Mohawk
Lower Hudson
Finger Lakes
Niagara



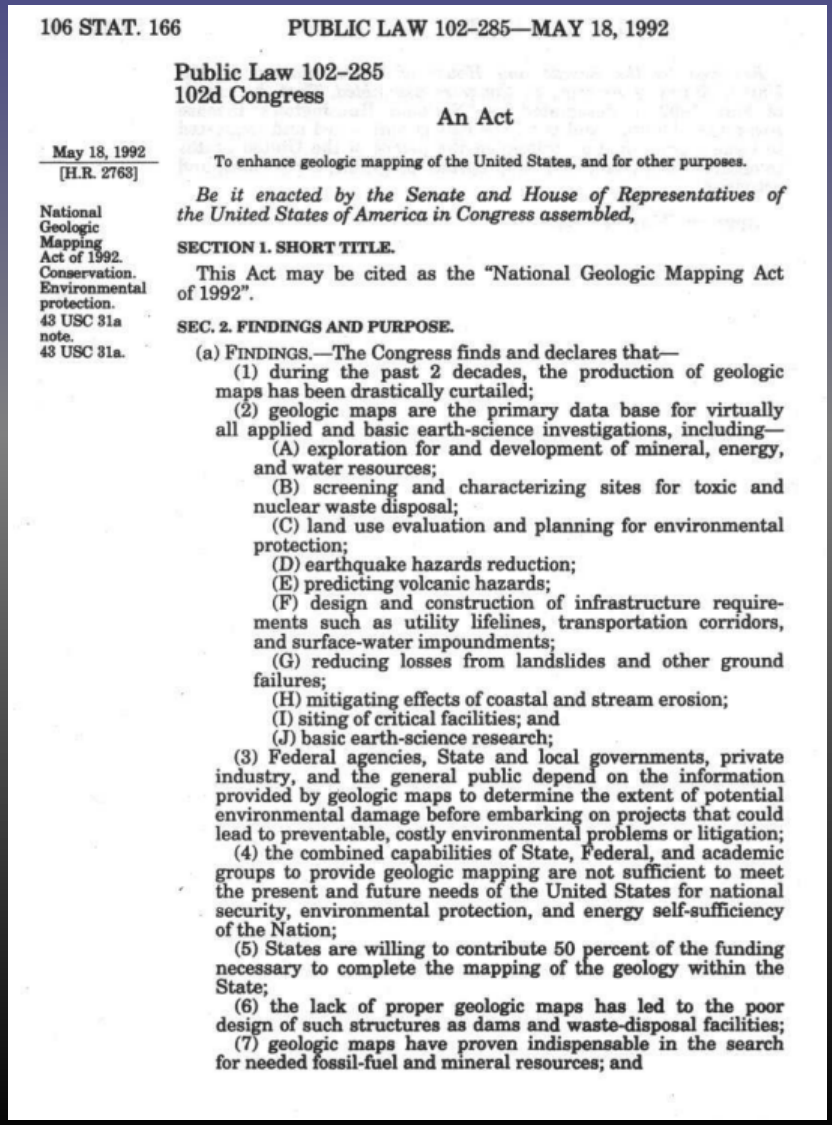
STATEMAP and the NYSM - GS

Geologic Mapping in NYS funded by the act since 1993

Over 200 geologic maps published or conducted by direct funding from STATEMAP

Mapped over a one- or two-year grant cycle

Published digital and/or paper map end product



106 STAT. 166 PUBLIC LAW 102-285—MAY 18, 1992

Public Law 102-285
102d Congress

An Act

May 18, 1992
[H.R. 2763]

To enhance geologic mapping of the United States, and for other purposes.

National Geologic Mapping Act of 1992. Conservation. Environmental protection. 43 USC 31a note. 43 USC 31a.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Geologic Mapping Act of 1992".

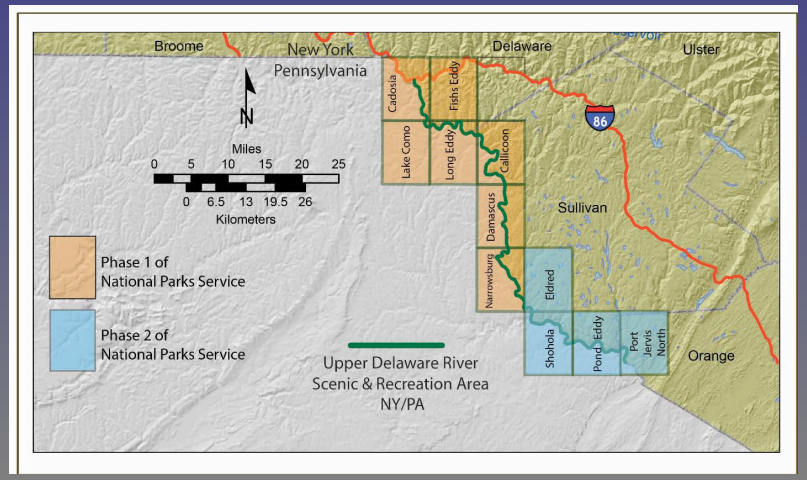
SEC. 2. FINDINGS AND PURPOSE.

(a) FINDINGS.—The Congress finds and declares that—
(1) during the past 2 decades, the production of geologic maps has been drastically curtailed;
(2) geologic maps are the primary data base for virtually all applied and basic earth-science investigations, including—
(A) exploration for and development of mineral, energy, and water resources;
(B) screening and characterizing sites for toxic and nuclear waste disposal;
(C) land use evaluation and planning for environmental protection;
(D) earthquake hazards reduction;
(E) predicting volcanic hazards;
(F) design and construction of infrastructure requirements such as utility lifelines, transportation corridors, and surface-water impoundments;
(G) reducing losses from landslides and other ground failures;
(H) mitigating effects of coastal and stream erosion;
(I) siting of critical facilities; and
(J) basic earth-science research;
(3) Federal agencies, State and local governments, private industry, and the general public depend on the information provided by geologic maps to determine the extent of potential environmental damage before embarking on projects that could lead to preventable, costly environmental problems or litigation;
(4) the combined capabilities of State, Federal, and academic groups to provide geologic mapping are not sufficient to meet the present and future needs of the United States for national security, environmental protection, and energy self-sufficiency of the Nation;
(5) States are willing to contribute 50 percent of the funding necessary to complete the mapping of the geology within the State;
(6) the lack of proper geologic maps has led to the poor design of such structures as dams and waste-disposal facilities;
(7) geologic maps have proven indispensable in the search for needed fossil-fuel and mineral resources; and

Current and Former Federal Funding Sources

National Park Service

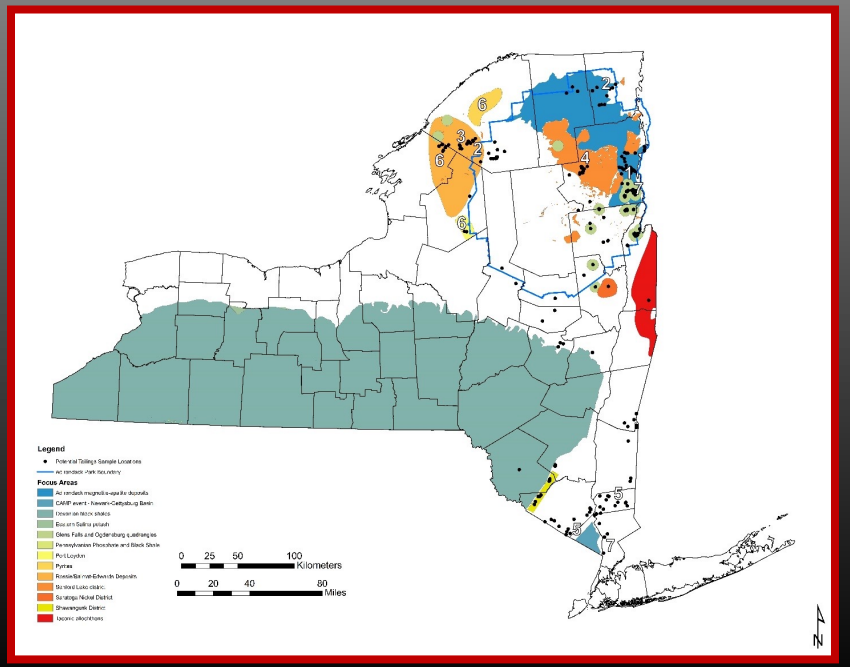
- Mapped eleven 7.5-Minute quadrangles along the Delaware River from 2015-2019



Great Lakes Geologic Mapping Coalition (GLGMC)

- Conduct three-dimensional mapping of over 20 quadrangles and critical stratigraphic sites:

Mainly in the Finger Lakes, Black River and Hudson Valley Regions



Earth Mineral Resource Initiative (EarthMRI)

- Mine waste tailing mapping and sampling

-Possible future geologic mapping and drilling

So what are the Surficial Mapping Protocols (SuMP) at the NYSGS?

Surficial Mapping Protocols (SuMP)

Created in 2019 as an Open-File Report

Used specifically for surficial geologic mapping

Set minimum requirements for mapping:

1). Minimum quantity of stops and soil samples

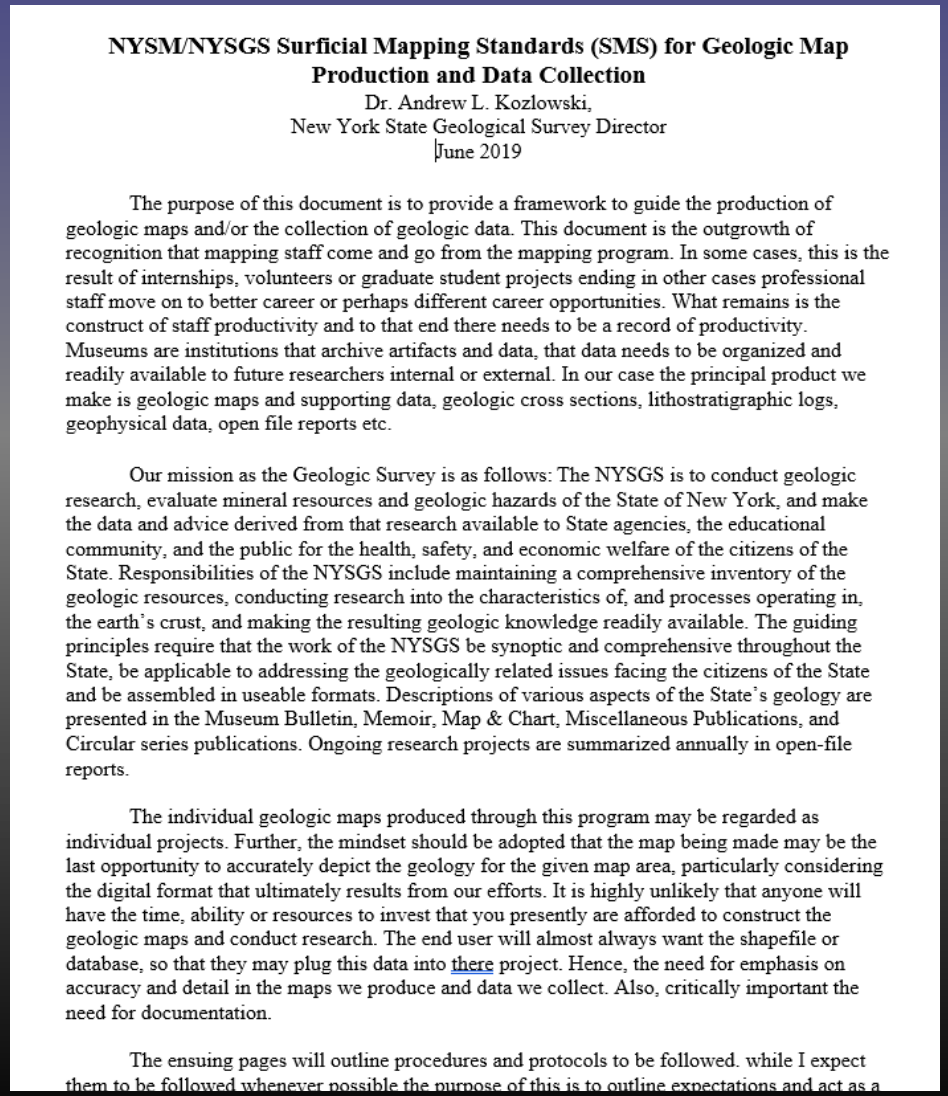
2). Descriptive notes at each stop

3). Field summary AKA debriefing report

4). Data Cataloging

5). Lithology/Digitization Standardization

6). GeMS Compliant Data



NYSM/NYSGS Surficial Mapping Standards (SMS) for Geologic Map Production and Data Collection

Dr. Andrew L. Kozlowski,
New York State Geological Survey Director
June 2019

The purpose of this document is to provide a framework to guide the production of geologic maps and/or the collection of geologic data. This document is the outgrowth of recognition that mapping staff come and go from the mapping program. In some cases, this is the result of internships, volunteers or graduate student projects ending in other cases professional staff move on to better career or perhaps different career opportunities. What remains is the construct of staff productivity and to that end there needs to be a record of productivity. Museums are institutions that archive artifacts and data, that data needs to be organized and readily available to future researchers internal or external. In our case the principal product we make is geologic maps and supporting data, geologic cross sections, lithostratigraphic logs, geophysical data, open file reports etc.

Our mission as the Geologic Survey is as follows: The NYSGS is to conduct geologic research, evaluate mineral resources and geologic hazards of the State of New York, and make the data and advice derived from that research available to State agencies, the educational community, and the public for the health, safety, and economic welfare of the citizens of the State. Responsibilities of the NYSGS include maintaining a comprehensive inventory of the geologic resources, conducting research into the characteristics of, and processes operating in, the earth's crust, and making the resulting geologic knowledge readily available. The guiding principles require that the work of the NYSGS be synoptic and comprehensive throughout the State, be applicable to addressing the geologically related issues facing the citizens of the State and be assembled in useable formats. Descriptions of various aspects of the State's geology are presented in the Museum Bulletin, Memoir, Map & Chart, Miscellaneous Publications, and Circular series publications. Ongoing research projects are summarized annually in open-file reports.

The individual geologic maps produced through this program may be regarded as individual projects. Further, the mindset should be adopted that the map being made may be the last opportunity to accurately depict the geology for the given map area, particularly considering the digital format that ultimately results from our efforts. It is highly unlikely that anyone will have the time, ability or resources to invest that you presently are afforded to construct the geologic maps and conduct research. The end user will almost always want the shapefile or database, so that they may plug this data into there project. Hence, the need for emphasis on accuracy and detail in the maps we produce and data we collect. Also, critically important the need for documentation.

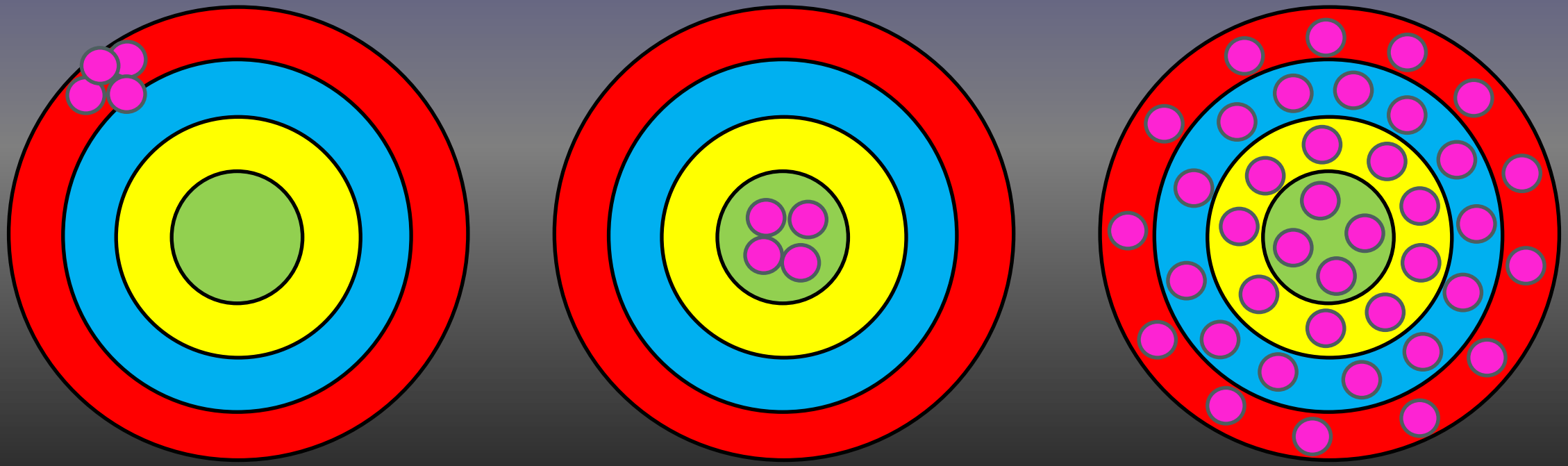
The ensuing pages will outline procedures and protocols to be followed. while I expect them to be followed whenever possible the purpose of this is to outline expectations and act as a

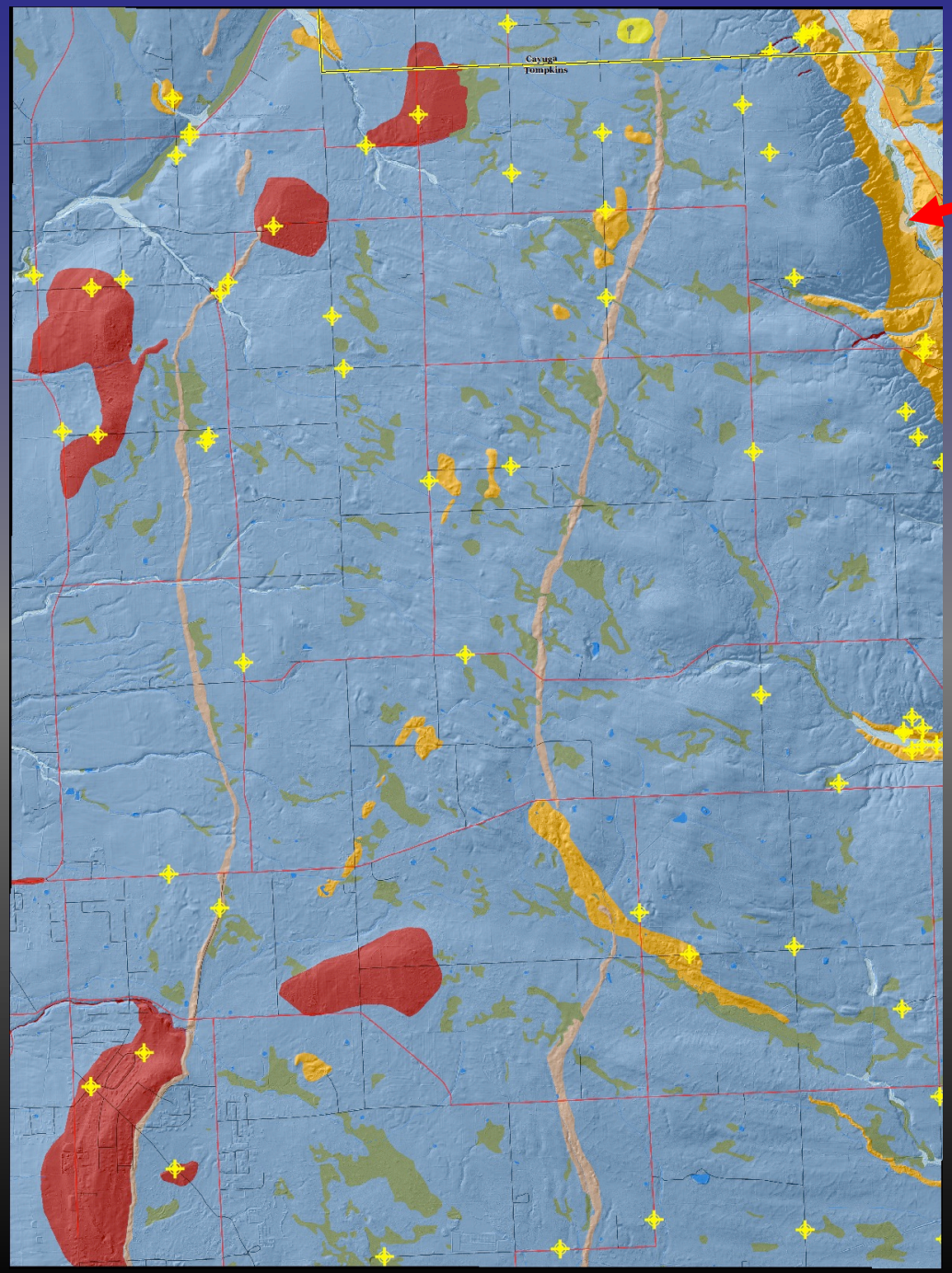
One reasoning behind the SuMP

Precision

Accuracy

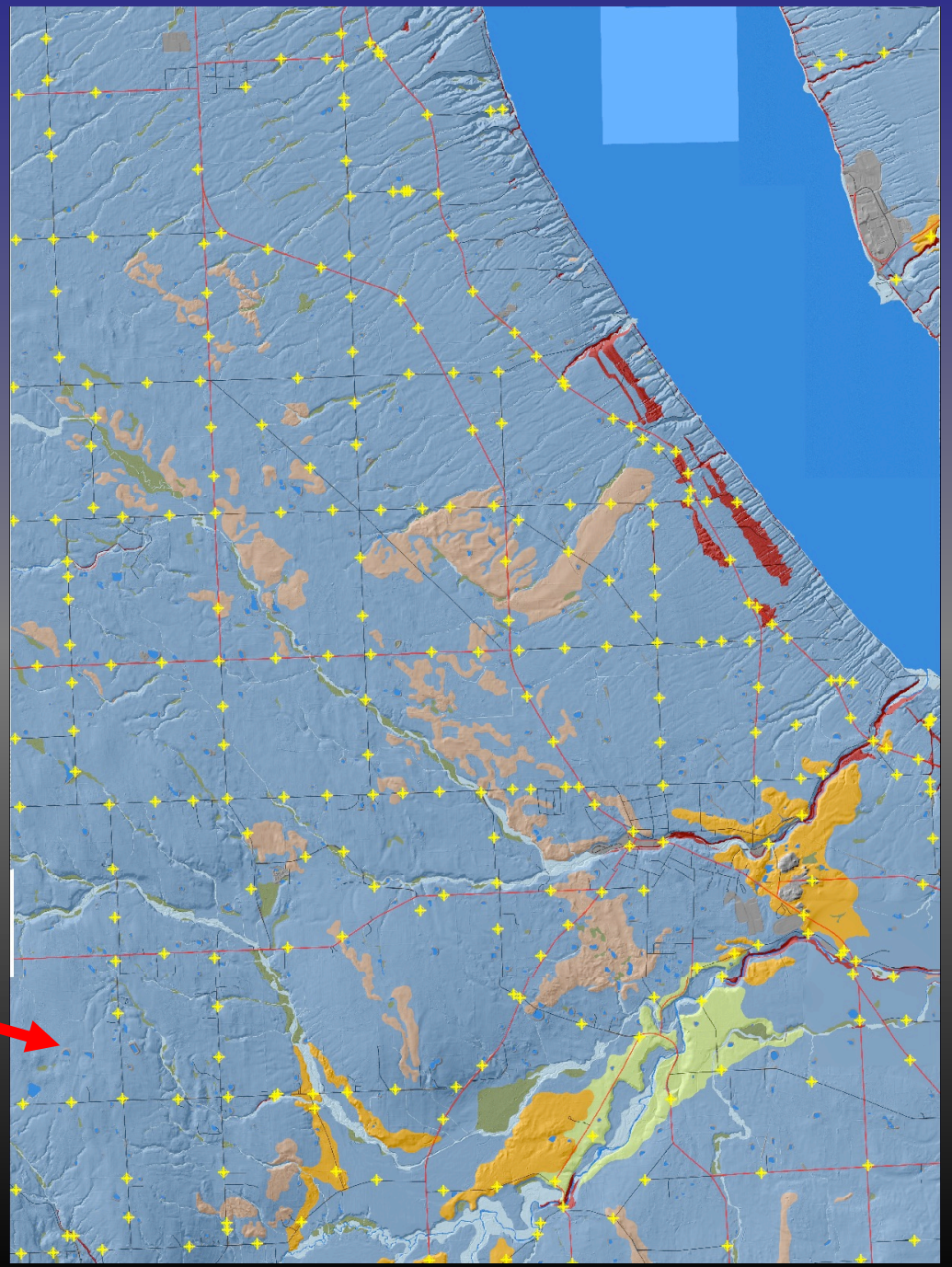
Coverage
AKA
Quantity





Before

After



Geologic Mapping Schema (GeMS)

Started in 2009 as NCGMP09

Continued development and renamed

First set of true nationwide, NCGMP funded GIS standards for deliverables

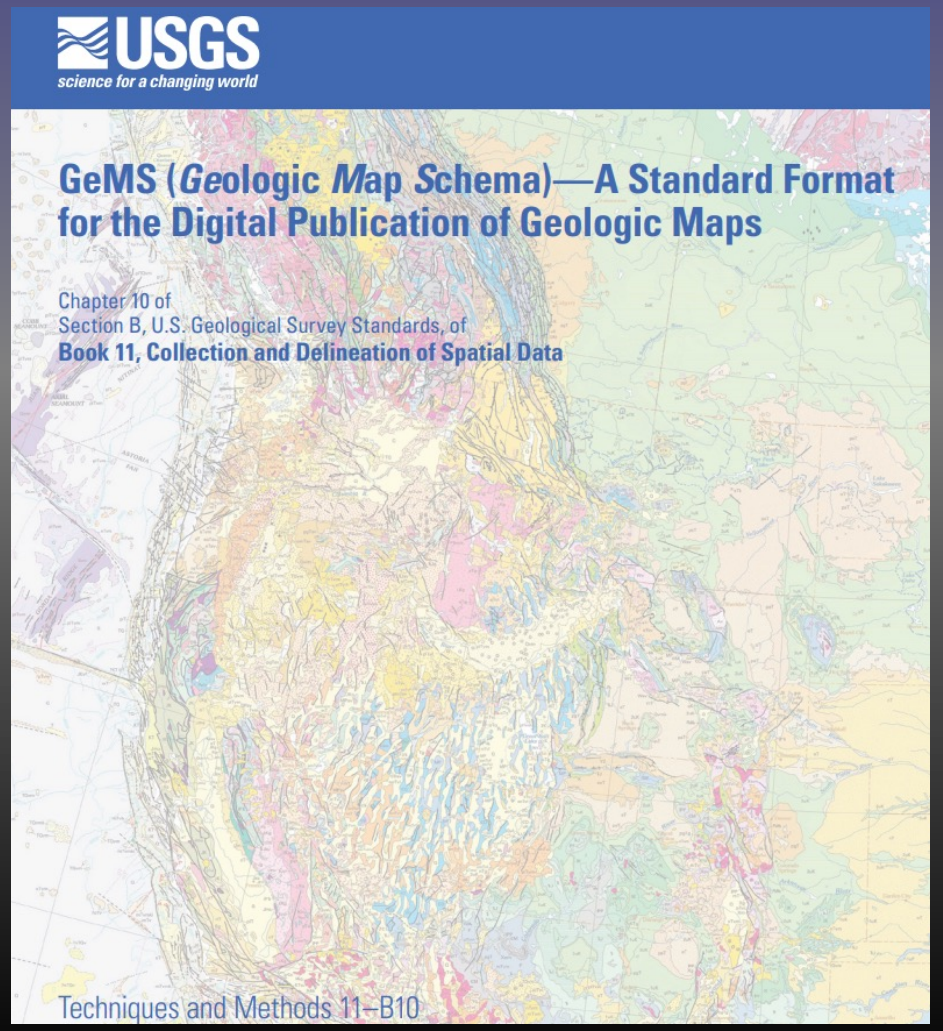
Standards for:

1). Polygons, Polylines, Points

2). Metadata

3). Database files

4). Deliverable directories, folders and images



How to these coalesce?

SuMP is the field mapping component

Standards for field work and data logging for all mapping projects conducted by the NYSGS

Data standards allow for fluid transitions from one geologist to the next

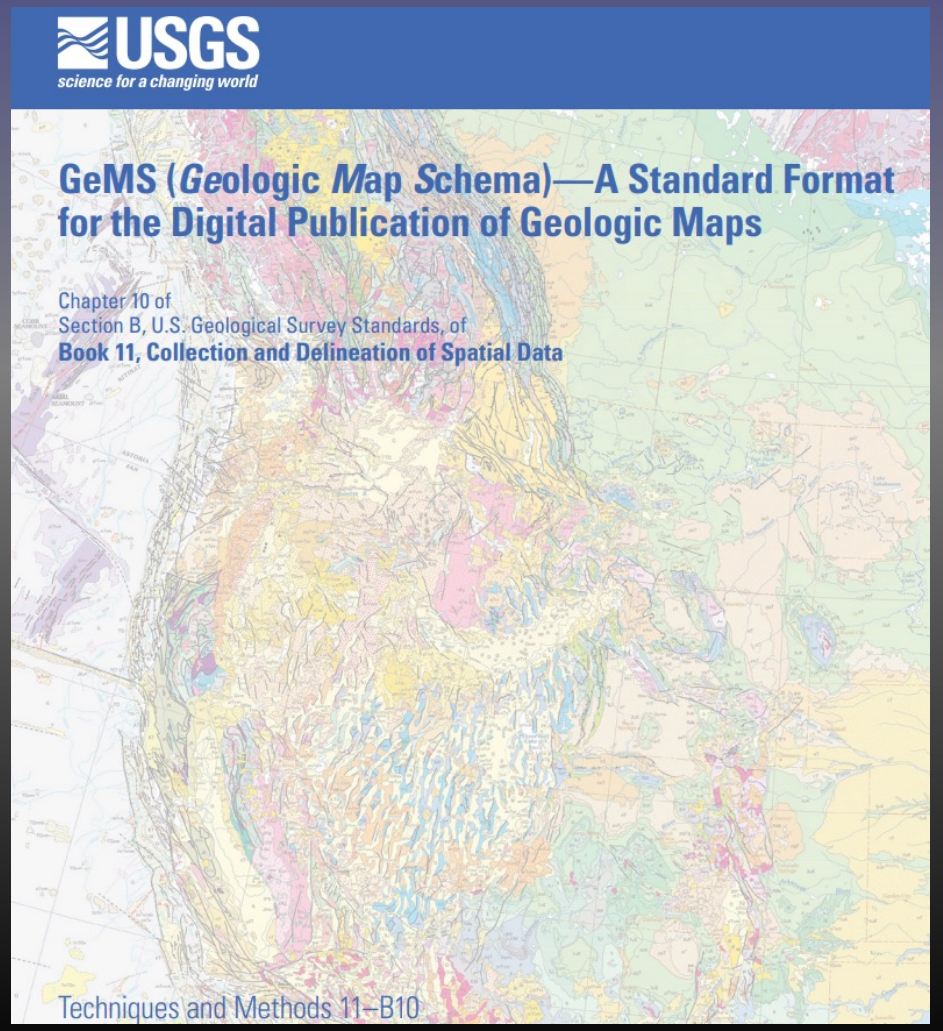
Allows for ease of use for cartography and large-scale mapping projects

GeMS is for the office

Cartographic and GIS standards for all mapping products produced by NYSGS for the USGS

Data standards allow for workflow development for ease of use and compilation for large projects.

Allows for ease of use for cartography and large-scale mapping projects (sounds familiar!)



What is our workflow for conducting geologic mapping?

Process of Geologic Mapping

Create Field Map of the 7.5-Minute Quadrangle

Conduct Field Mapping

Roadside Sampling

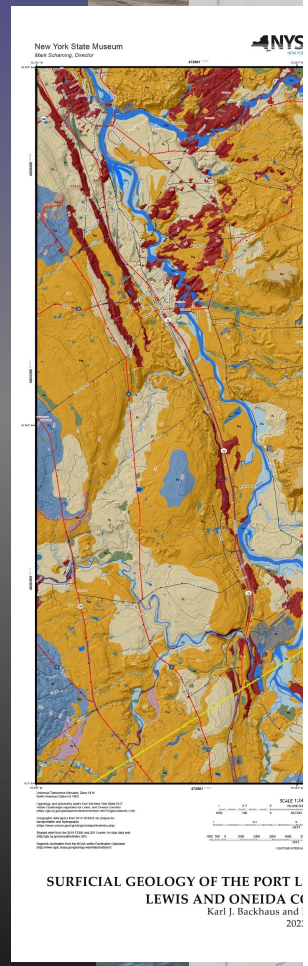
Field Traverses

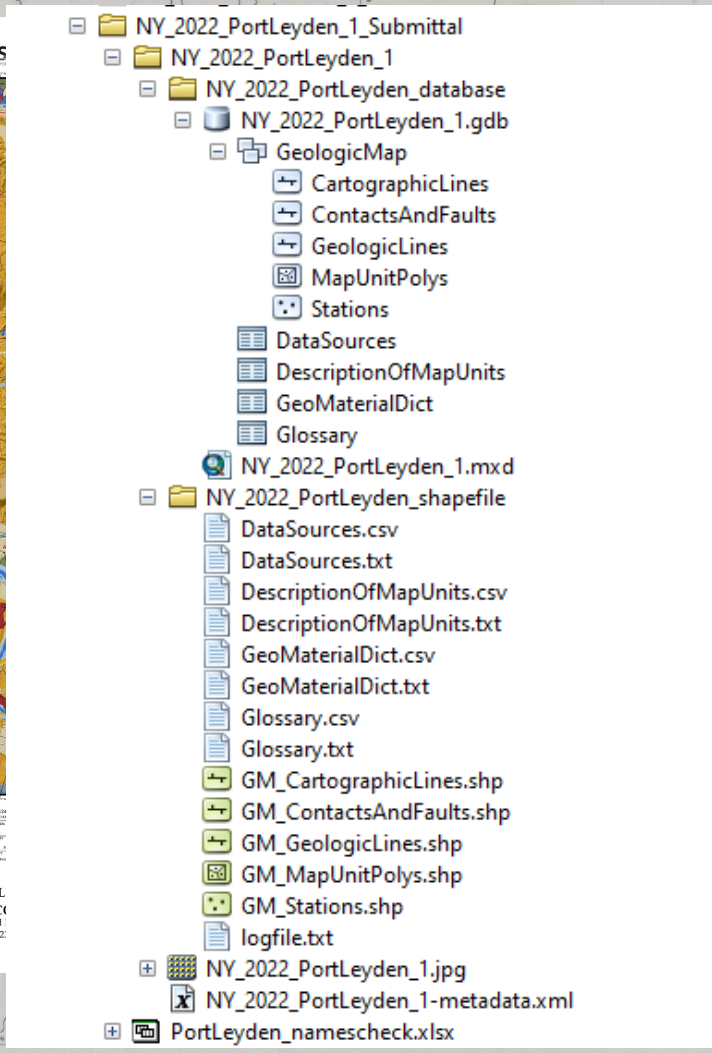
Digital Map Compilation

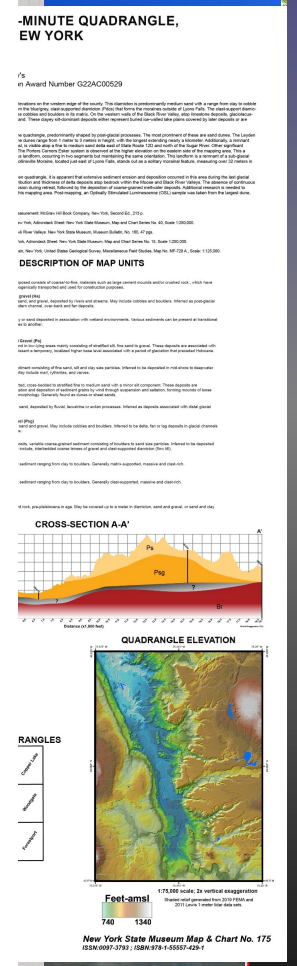
Drafting

GeMS Compliant Digital Map Database Compilation

Publish in NYSM Map and Chart Series & NGMDB







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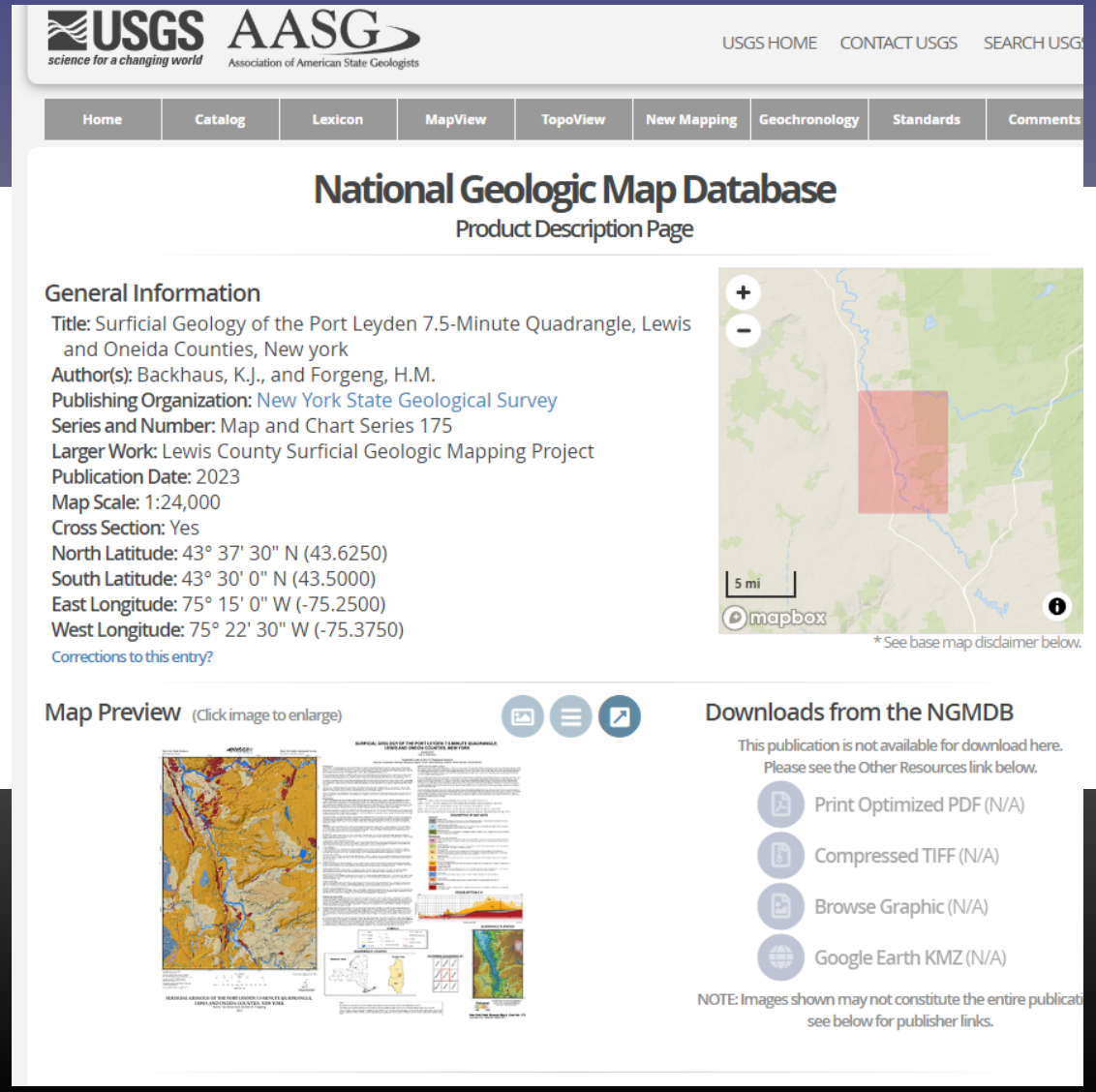
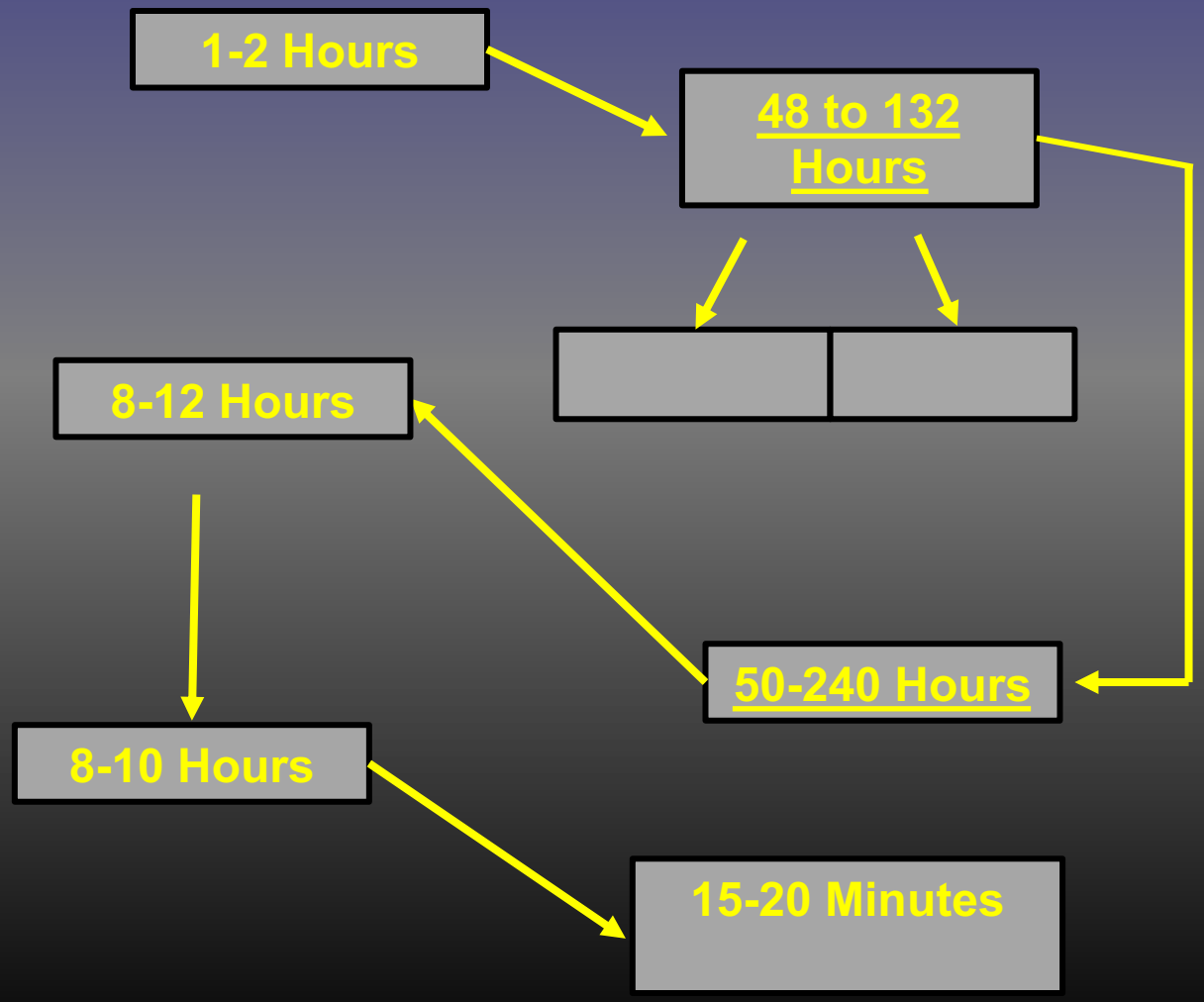


Timing of the Process of Geologic Mapping

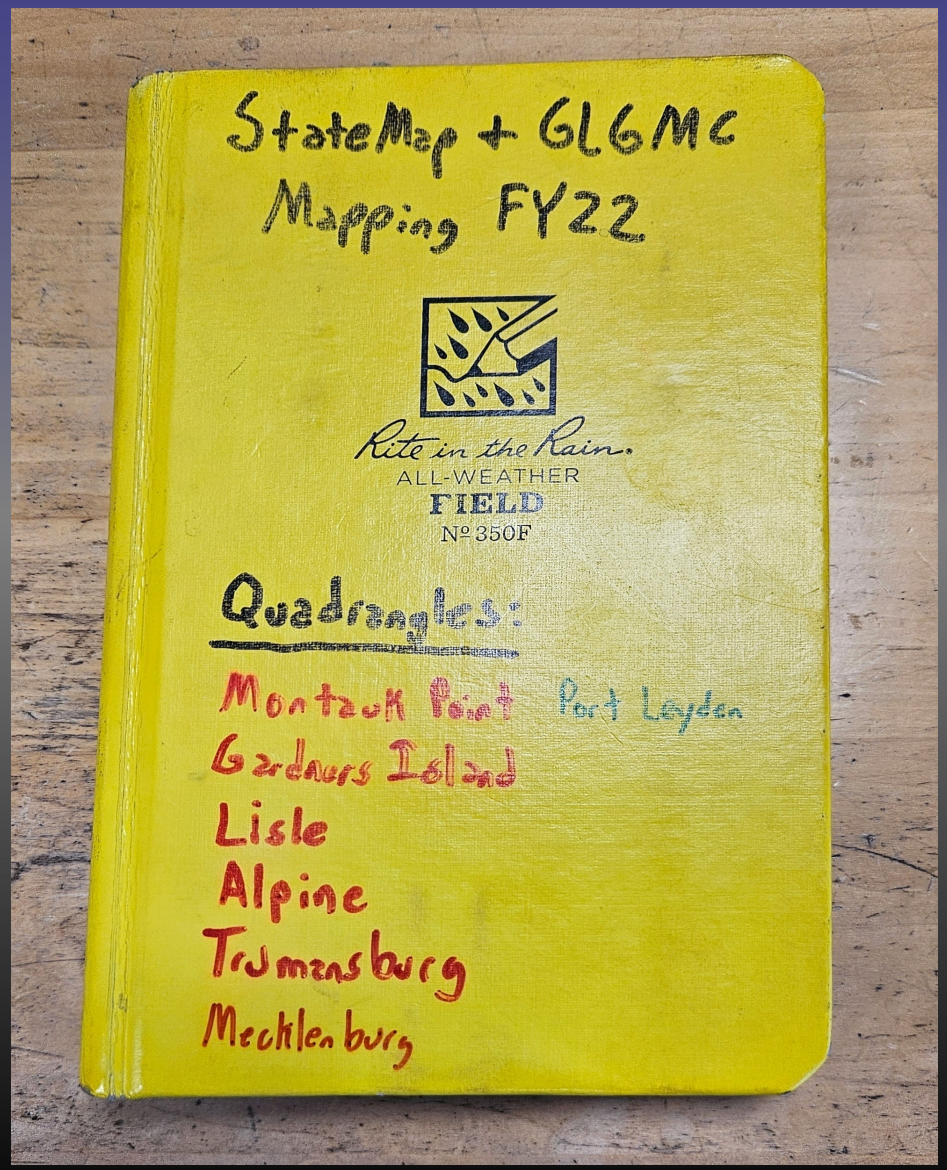


Surficial Geology of the Port Leyden 7.5-Minute Quadrangle:

Field Map Creation: 2 hours
Field Work: 72 Hours
Drafting: 240 Hours
Final Map Compilation: 5 Hours
GeMS Compilation: 6 hours
Publishing: 10 Minutes

Total: 325.6 Hours

Start to finish through SMS and GeMS



1). Field Work

GeMS Final Geodatabase

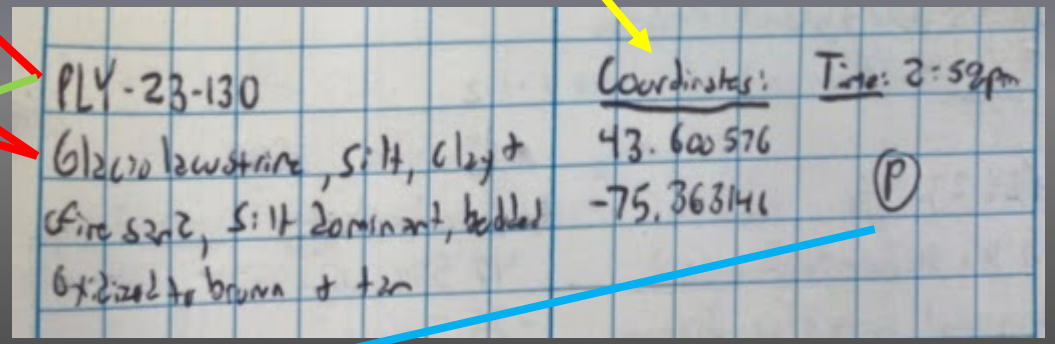
MapUnitPolys	required
OrientationPoints	as-needed
OverlayPolys	as-needed
Stations	as-needed
DataSources	required
DescriptionOfMapUnits	required
GeoMaterialDict	required
Glossary	required
MiscellaneousMapInformation	optional
RepurposedSymbols	as-needed
StandardLithology	optional

Start to finish through SMS and GeMS

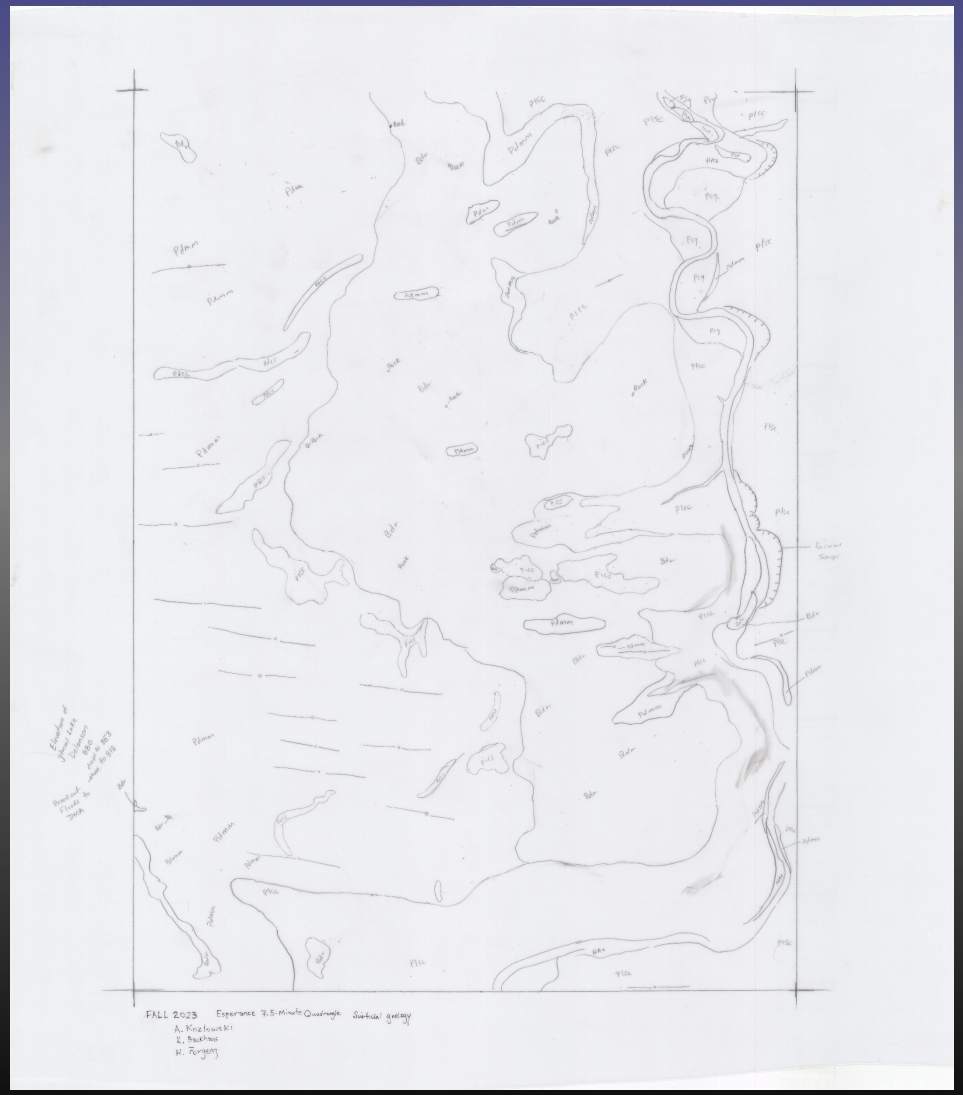
[See also, tables 20, 21, 25]

Field name
FieldID
LocationConfidenceMeters
ObservedMapUnit
MapUnit
Symbol
Label
PlotAtScale
DataSourceID
Notes
Stations_ID

TimeDate
Observer
SignificantDimensionMeters
LocationMethod
GPSX
GPSY



Start to finish through SMS and GeMS



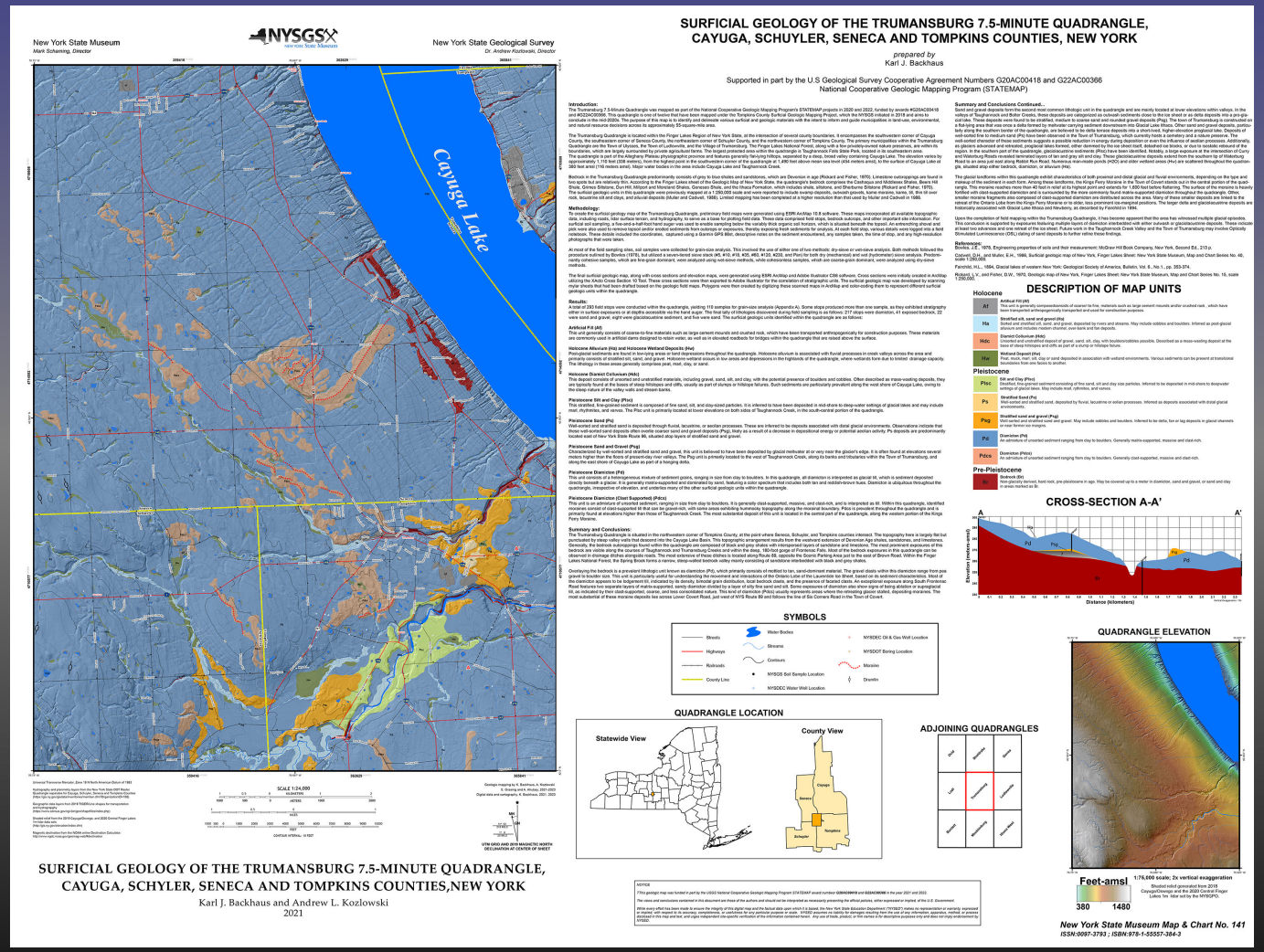
2). Drafting

1). Field Work

GeMS Final Geodatabase

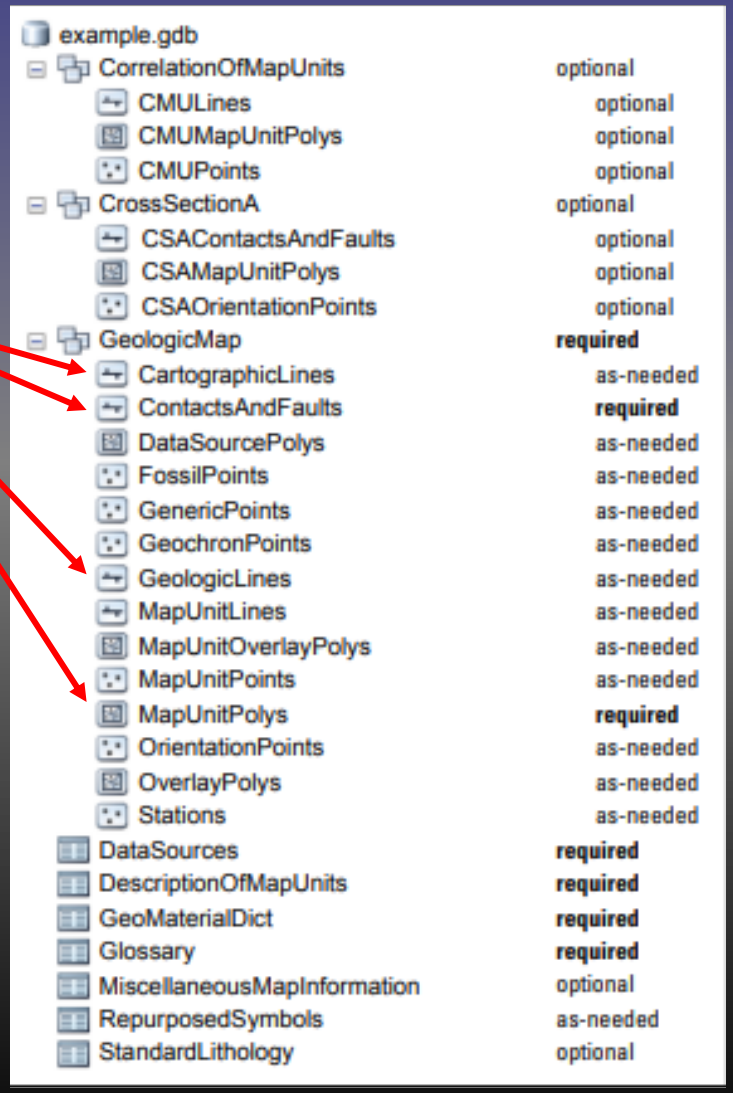
example.gdb	
CorrelationOfMapUnits	optional
CMULines	optional
CMUMapUnitPolys	optional
CMUPoints	optional
CrossSectionA	optional
CSAContactsAndFaults	optional
CSAMapUnitPolys	optional
CSAOrientationPoints	optional
GeologicMap	**required**
CartographicLines	as-needed
ContactsAndFaults	**required**
DataSourcePolys	as-needed
FossilPoints	as-needed
GenericPoints	as-needed
GeochronPoints	as-needed
GeologicLines	as-needed
MapUnitLines	as-needed
MapUnitOverlayPolys	as-needed
MapUnitPoints	as-needed
MapUnitPolys	**required**
OrientationPoints	as-needed
OverlayPolys	as-needed
Stations	as-needed
DataSources	**required**
DescriptionOfMapUnits	**required**
GeoMaterialDict	**required**
Glossary	**required**
MiscellaneousMapInformation	optional
RepurposedSymbols	as-needed
StandardLithology	optional

Start to finish through SMS and GeMS

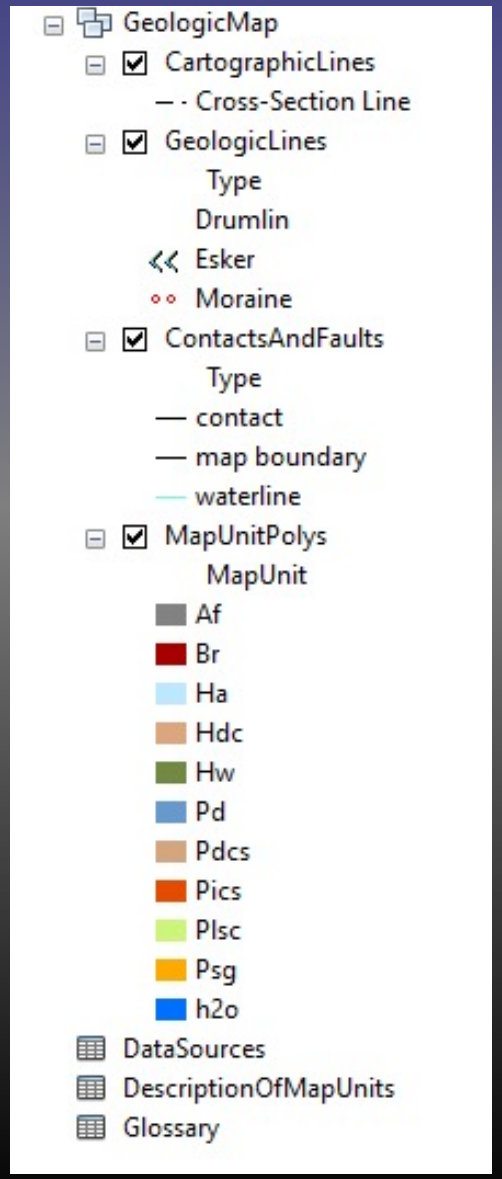


GeMS Final Geodatabase

3). Digitization



Start to finish through SMS and GeMS



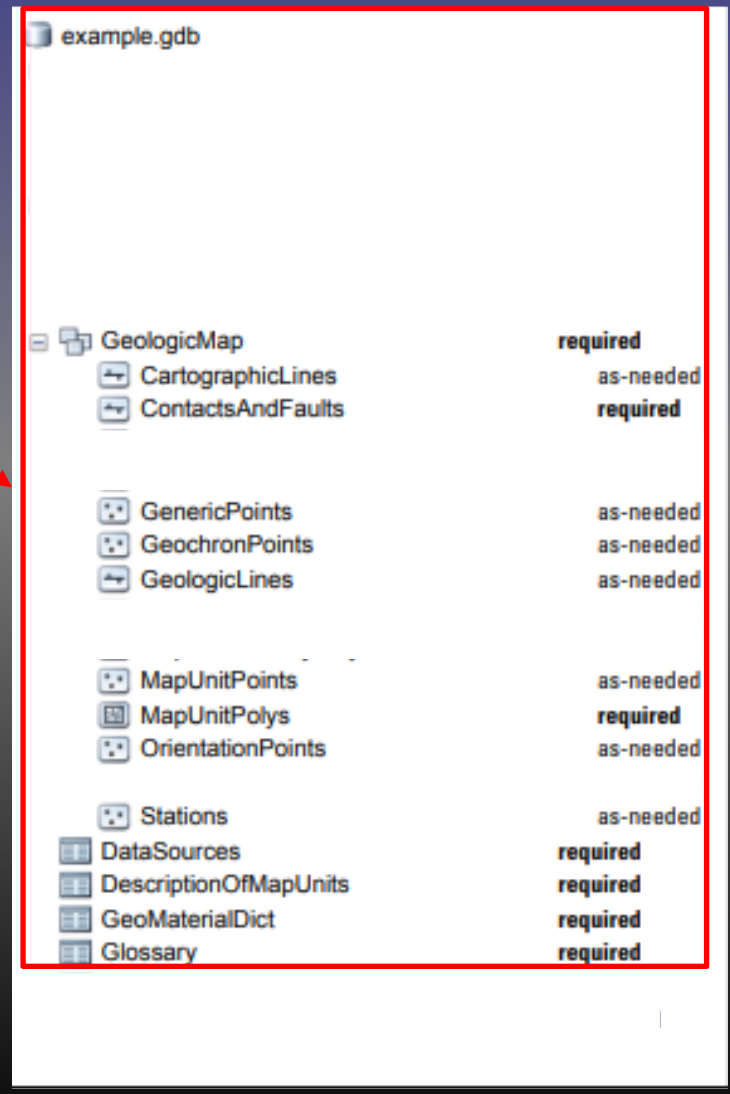
4). Database Compilation

3). Digitization

2). Drafting

1). Field Work

GeMS Final Geodatabase



Start to finish through SMS and GeMS

5). Final Project Folder

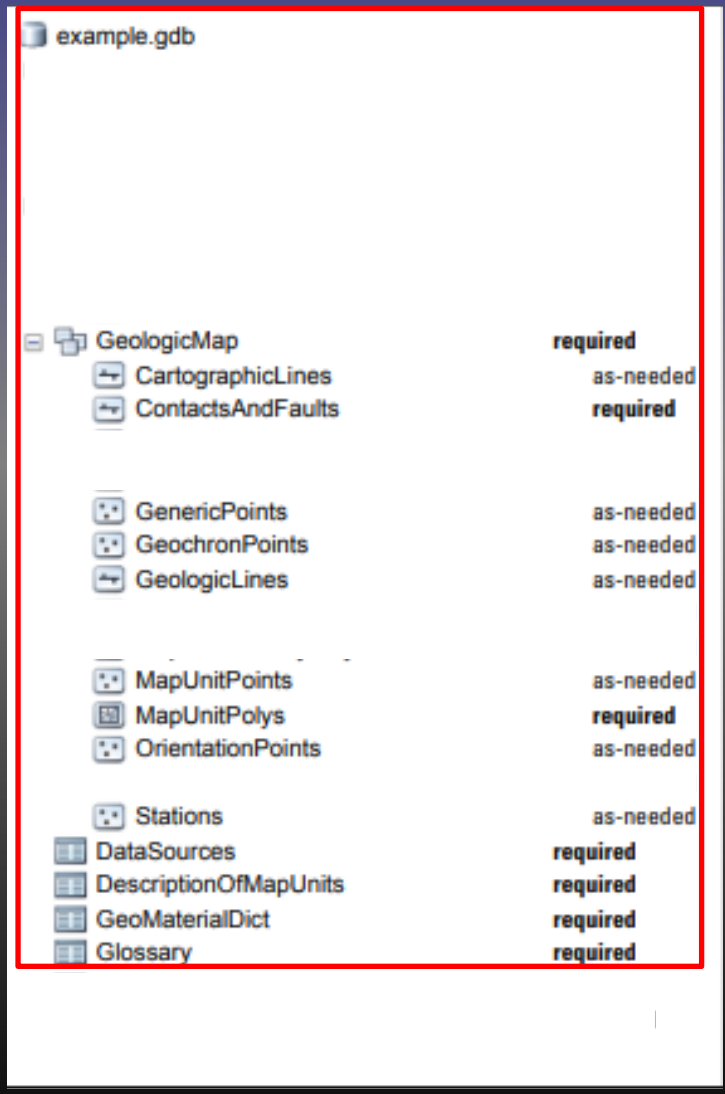
4). Database Compilation

3). Digitization

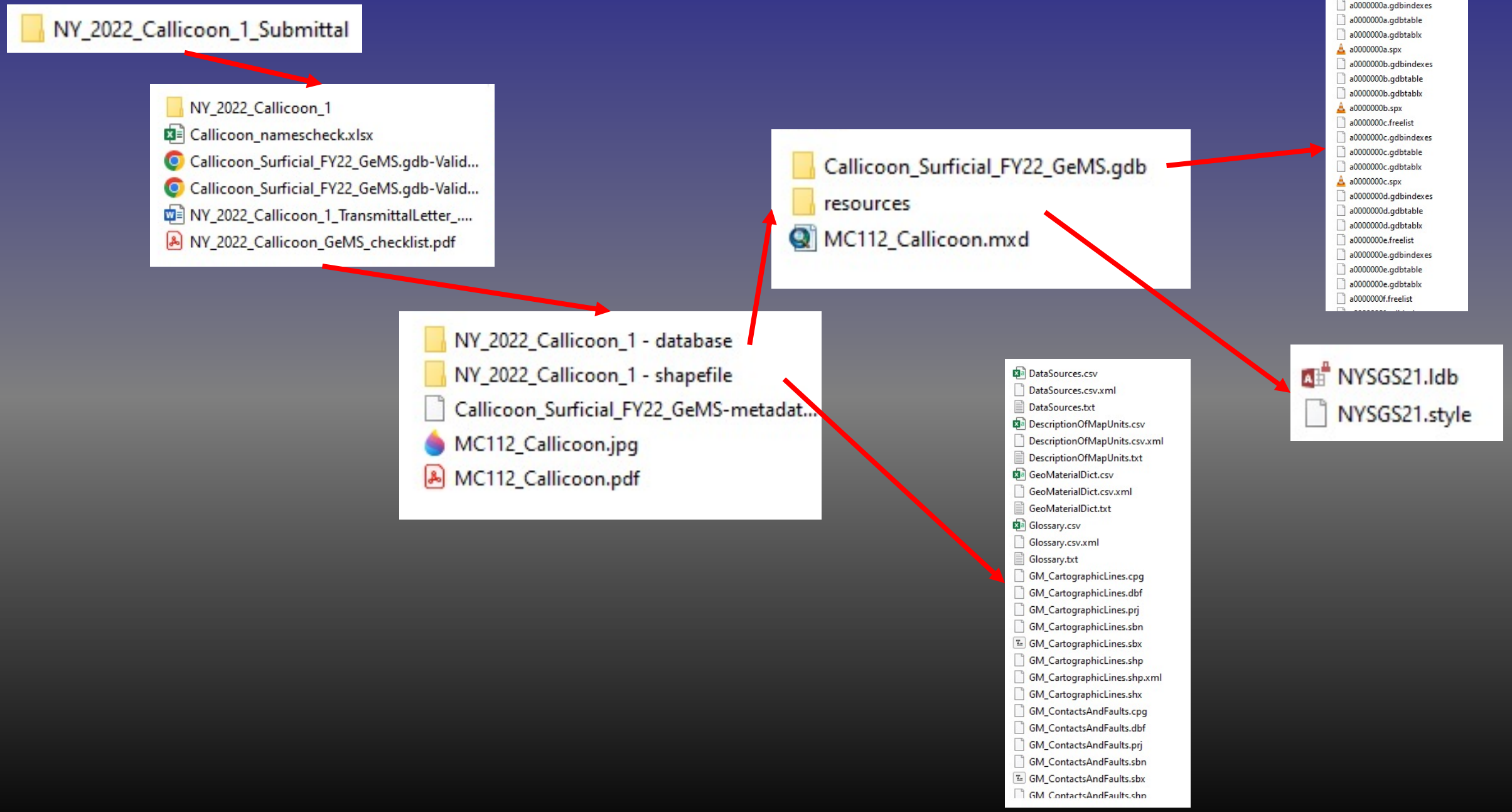
2). Drafting

1). Field Work

GeMS Final Geodatabase



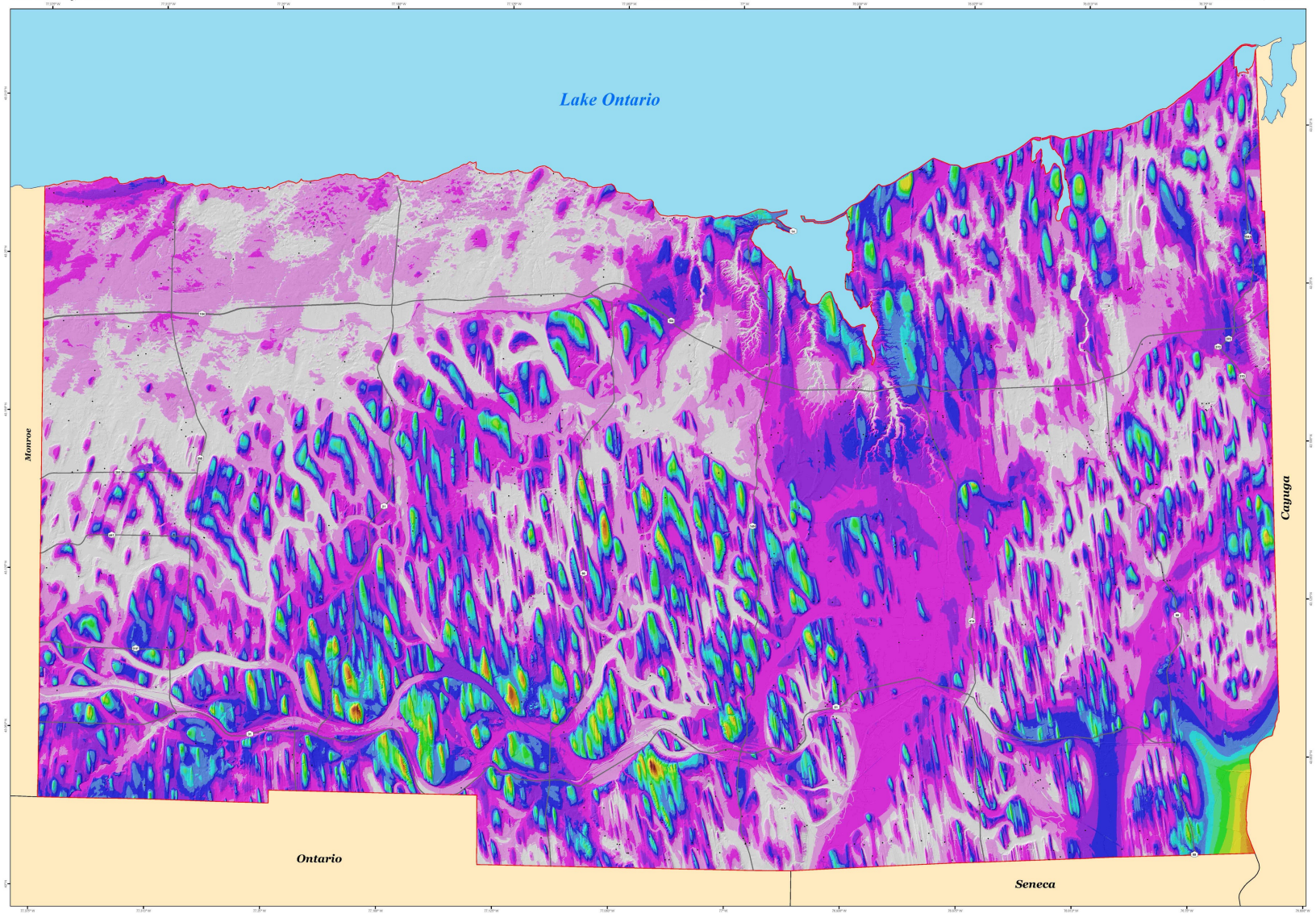
Final GeMS Submittal Folder Tree



New York State Museum
Mark Schaming, Director

NYSGSX
NEW YORK State Museum

New York State Geological Survey
Dr. Andrew L. Kozlowski, Director



Digital Data and Cartography by K. Backhaus and B. Bird, 2016-22

Universal Transverse Mercator, Zone 18 N North American Datum of 1983

Geographic and hydrography data obtained from the NYSGIS Clearinghouse (https://gis.ny.gov/)

Shaded relief from Seneca Watershed 2m, Great Lakes Oswego 1m, and Cayuga/Oswego Counties 1m Lidar data sets by NYSGPO (http://gis.ny.gov/elevation/index.cfm)

SCALE 1:62,500

Kilometers 0 1.5 3 6 12
Meters 0 6,000 12,000
Miles 0 2 4
Feet 0 4,000 8,000 16,000 24,000 32,000

DRIFT THICKNESS OF WAYNE COUNTY, NEW YORK

Karl J. Backhaus

2023

Introduction

Beginning in 2019, under the guidance and funding provided by the United States Geological Survey - Great Lakes Geological Mapping Coalition (award G20AC00401), the New York State Museum - Geological Survey began a statewide effort to conduct geologic mapping of bedrock elevations throughout New York. Wayne County, of western New York, lies entirely in the Erie-Ontario Lowlands physiographic province. The county is surrounded by four adjacent counties: Cayuga, Monroe, Ontario and Seneca. Wayne County is also located along the south shore of Lake Ontario. Surficial and subsurface bedrock point data and maps were compiled from publicly available sources, vetted, and organized into a comprehensive geospatial database. A technical workflow was developed to categorize the overall geology and differentiate between the underlying bedrock and overlying unconsolidated sediments. The resulting bedrock elevation map provides a detailed representation of bedrock topography across Wayne County. This map is useful for various applications, including geological studies, engineering and construction, natural resource management (such as water or mineral resources), and environmental studies.

Methodology

A total of 827 bedrock control points were used to delineate bedrock topography in Wayne County. These points consisted of 782 water wells, 13 engineering boreholes, 12 exploratory boreholes, 11 bedrock field stops, six known bedrock outcrops and three oil and gas wells. These data were compiled from a variety of public sources and imported into ESRI's ArcMap 10.8 software platform. Ground surface elevations for all control points were extracted from a compilation of three separate digital elevation models (DEM) which were resampled to match a 1-meter LIDAR DEM cell size. Bedrock elevations were calculated at each location by subtracting the depth-to-bedrock from the ground surface elevation. 50-foot bedrock elevation contours were auto-generated and manually refined through a multi-step quality control process to resolve any interpolation errors. The finalized contours were converted into a 1-meter raster, using the "Topo to Raster" tool, that represents county-wide bedrock topography. Lastly, the "Raster Calculator" tool is used to subtract the surface elevation from the bedrock elevation to determine the thickness of the drift in the county.

Summary

The New York State Museum – Geological Survey has developed a detailed Drift Thickness Map for Wayne County. This map represents a compilation of various surficial and subsurface bedrock data sources, analytical methods, and quality control procedures. The resulting bedrock elevations reveal a range of distinct geological features including a variety of Paleozoic bedrock erosional profiles, and evidence of past glaciation. These characteristics are likely the result of a variety of functions including bedrock stratigraphy, structural deformation, and erosional processes such as past glaciation and fluvial geomorphology. This map is significant for applications in geological research, engineering, natural resource management, and environmental studies. Continued research and work on subsurface geology will provide additional data and insight and enhance the geologic framework of bedrock geology throughout New York State.

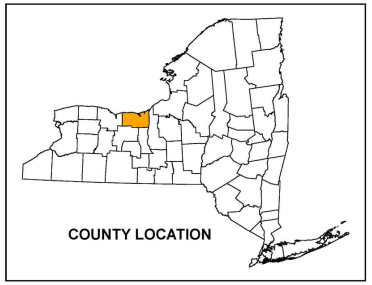
Explanation

- Data Point
- 50ft Drift Thickness Contour
- 100ft Drift Thickness Contour
- Highway
- Wayne County Line
- Adjacent County
- Water Body

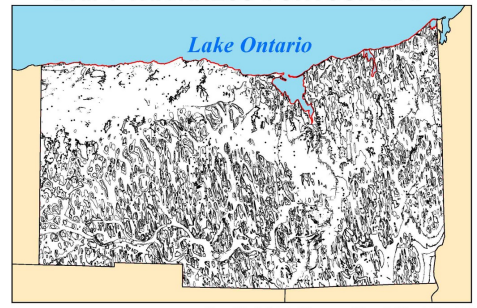
Drift Thickness

Feet Thick

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 320



DRIFT THICKNESS CONTOUR MAP



New York State Museum Map & Chart No. 167
ISSN:0097-3793 ; ISBN:978-1-55557-421-5

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Questions?

Thank you!