DIGITAL MAPPING TECHNIQUES 2021

The following was presented at DMT'21
(June 7 - 10, 2021 - A Virtual Event)

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2021)

http://ngmdb.usgs.gov/info/dmt/

Building an Automated GeMS-style Submission from an Enterprise Geodatabase

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The Maine Geological Survey has a seamless, statewide, multi-quadrangle and multi-scale enterprise geodatabase that is used to provide data management for all bedrock and surficial mapping products. This past year MGS developed the automation tools to convert and export our data into the GeMS schema. This has allowed us to continue mapping with our database schema and tools while also being able to meet Level 3 GeMS compliance requirements. It is also leading to quicker adoption of GeMS by the mapping geologists because the impact on their workflow has been minimized. This presentation will review the process that went into completing the project as well as open questions we still have to resolve.

How Did We Get Here?

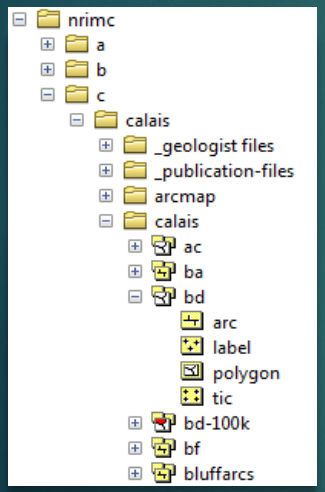
1996: Quadrangle-based mapping with ArcInfo Coverages

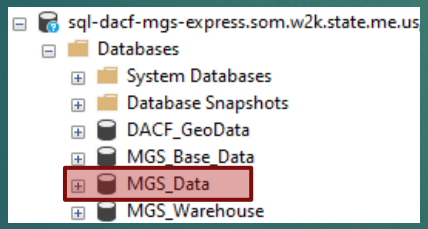
2014: SQL Server Express Enterprise Geodatabase multi-quadrangle, multi-scale, multi-map type

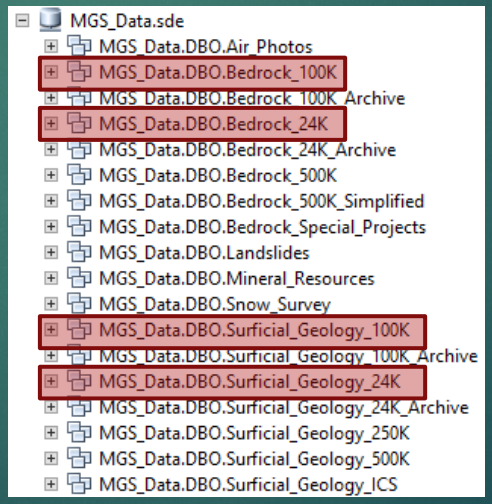
2017: NCGMP09

2018: MGS - GeMS gap analysis

2021: First GeMS submission







Guiding Principles

- Minimal disruption to current map production
- Minimal level of additional work by the mapping geologists and information management staff
- Treat GeMS as a data standard, not map standard
- Enable MGS to fully comply with GeMS Level 3 submission requirements
- Create a defined, scripted, documented workflow for bedrock and surficial maps at 24K and 100K scales
- Improve MGS workflows around GeoLex, feature-level metadata, map text

What Is Missing?

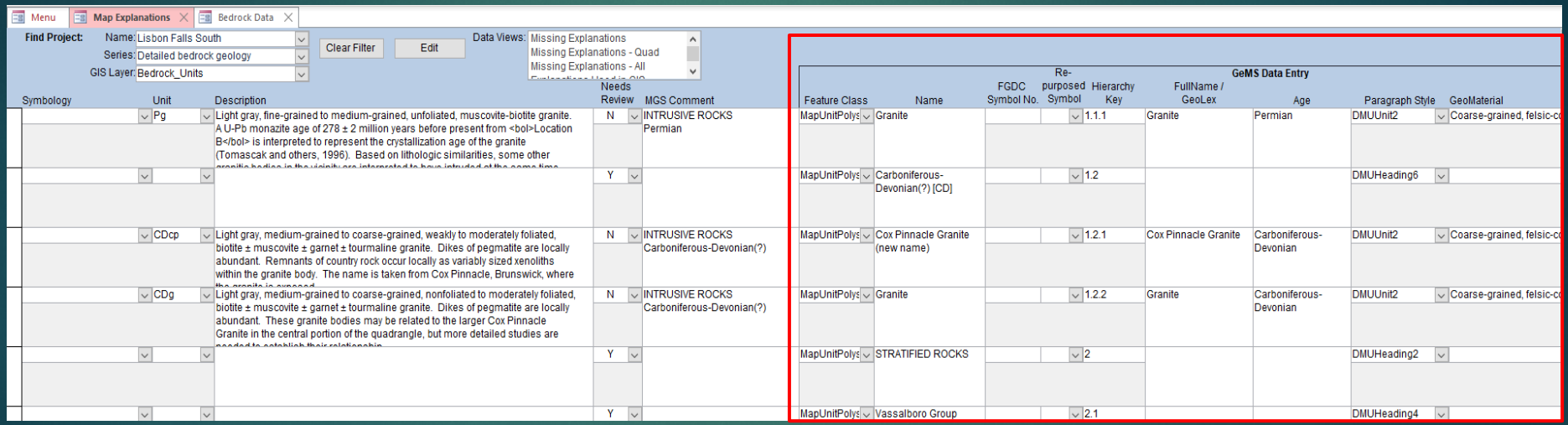
Inventoried MGS feature classes to discover required GeMS attributes that need to be captured.

GeMS Field	MGS Feature Class
IDENTITY_CONFIDENCE	• Bedrock_Contacts • Bedrock_Line_Features • Bedrock_Overlay_Polygons • Bedrock_Units • Bedrock_XSection_Lines • Bedrock_XSection_Overlay_Polygons • Bedrock_XSection_Units • tbl_Bedrock_Feature
EXISTENCE_CONFIDENCE	• Bedrock_Contacts • Bedrock_Line_Features • Bedrock_XSection_Lines
LOCATION_CONFIDENCE	• Bedrock_Contacts • Bedrock_Line_Features • Bedrock_XSection_Lines • tbl_Bedrock_Points
ORIENTATION_CONFIDENCE	• tbl_Bedrock_Feature
LOCATION_METHOD	• tbl_Bedrock_Points

List of additional fields needed for GeMS compliance in Bedrock 24K mapping feature classes and tables.

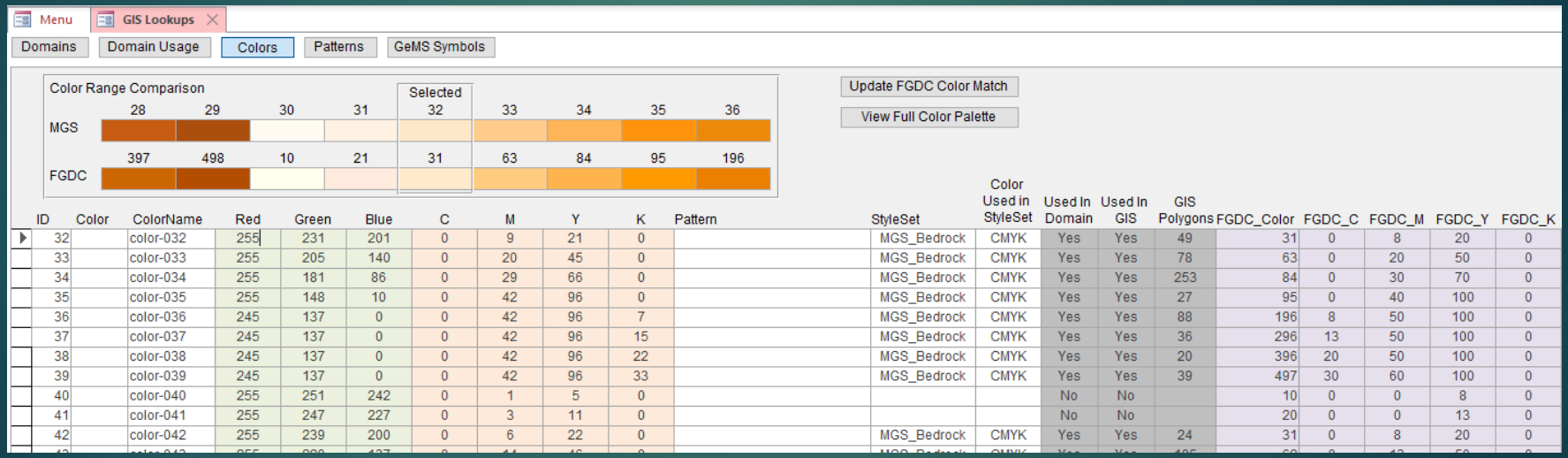
What Is Missing?

MGS map explanation table needed a number of new fields to control GeMS destination feature classes and description of map units.



Reference Tables

Reference tables for geomaterials, paragraph styles, and FGDC colors, symbols, and patterns were created in the MGS database to control data entry. In the case of colors and patterns, these tables also provide a crosswalk between the values traditionally used by MGS and the FGDC values.



Menu | GIS Lookups

Domains | Domain Usage | Colors | Patterns | GeMS Symbols

Color Range Comparison

	28	29	30	31	Selected 32	33	34	35	36
MGS									
FGDC	397	498	10	21	31	63	84	95	196

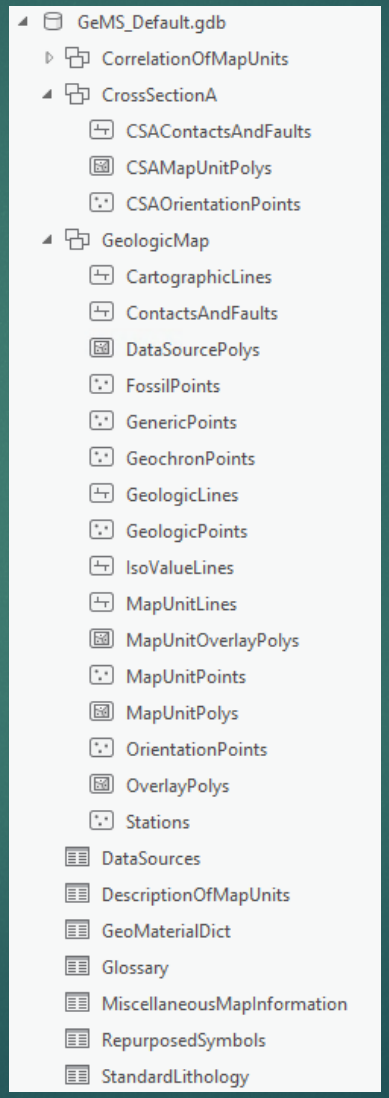
Update FGDC Color Match

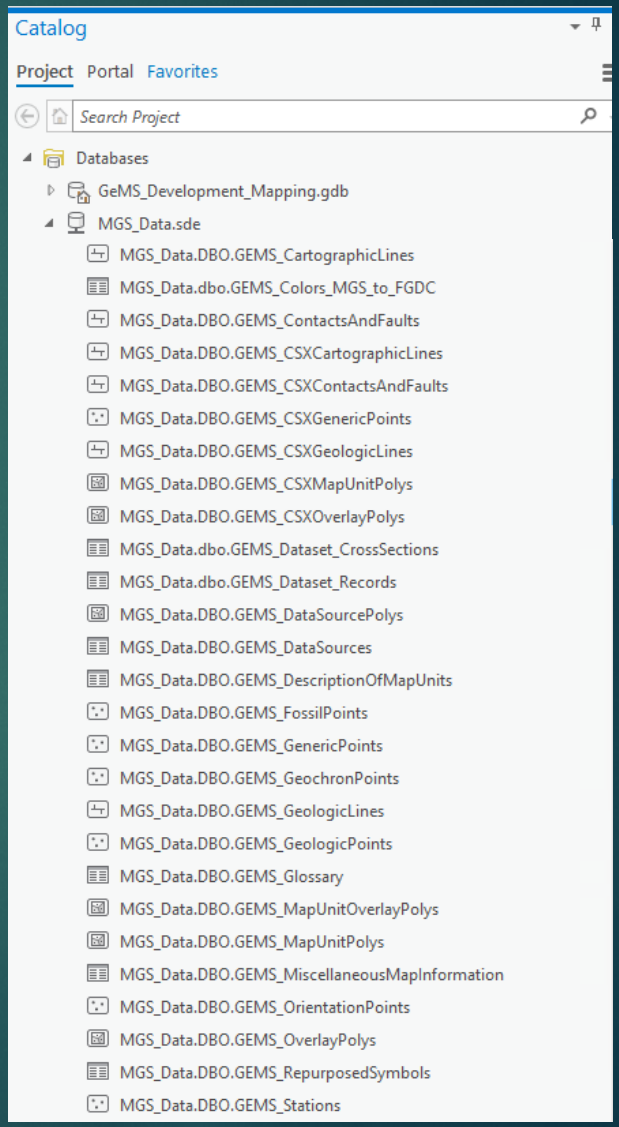
View Full Color Palette

ID	Color	ColorName	Red	Green	Blue	C	M	Y	K	Pattern	StyleSet	Color Used in StyleSet	Used In Domain	Used In GIS	GIS Polygons	FGDC_Color	FGDC_C	FGDC_M	FGDC_Y	FGDC_K
32		color-032	255	231	201	0	9	21	0		MGS_Bedrock	CMYK	Yes	Yes	49	31	0	8	20	0
33		color-033	255	205	140	0	20	45	0		MGS_Bedrock	CMYK	Yes	Yes	78	63	0	20	50	0
34		color-034	255	181	86	0	29	66	0		MGS_Bedrock	CMYK	Yes	Yes	253	84	0	30	70	0
35		color-035	255	148	10	0	42	96	0		MGS_Bedrock	CMYK	Yes	Yes	27	95	0	40	100	0
36		color-036	245	137	0	0	42	96	7		MGS_Bedrock	CMYK	Yes	Yes	88	196	8	50	100	0
37		color-037	245	137	0	0	42	96	15		MGS_Bedrock	CMYK	Yes	Yes	36	296	13	50	100	0
38		color-038	245	137	0	0	42	96	22		MGS_Bedrock	CMYK	Yes	Yes	20	396	20	50	100	0
39		color-039	245	137	0	0	42	96	33		MGS_Bedrock	CMYK	Yes	Yes	39	497	30	60	100	0
40		color-040	255	251	242	0	1	5	0				No	No		10	0	0	8	0
41		color-041	255	247	227	0	3	11	0				No	No		20	0	0	13	0
42		color-042	255	239	200	0	6	22	0		MGS_Bedrock	CMYK	Yes	Yes	24	31	0	8	20	0

GeMS Staging Tables

The GeMS Create New Database tool was used to create a file geodatabase with all the default tables and feature classes. These objects were imported into the MGS geodatabase to serve as staging tables/feature classes for GeMS data.





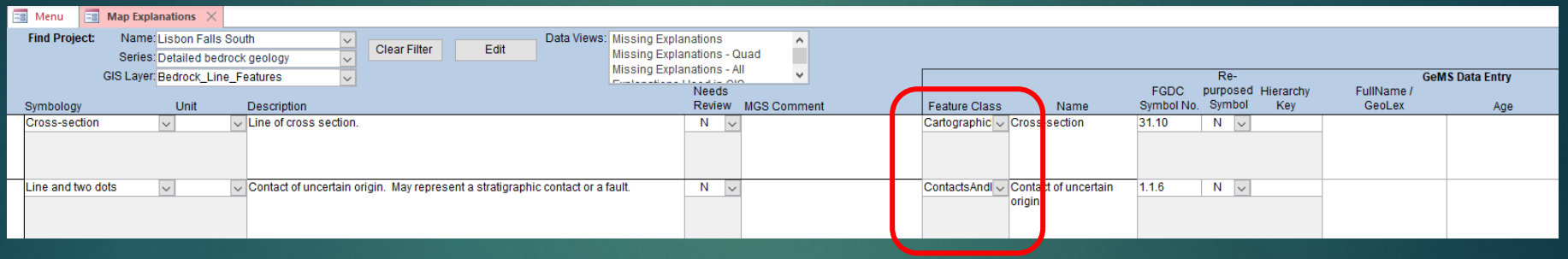
Data Mapping

The existing MGS feature classes and tables, or subsets of features, were mapped to the required GeMS feature classes and tables.

MGS Feature Class (criteria)	GeMS Feature Class
Units	MapUnitPolys
Contacts (not overlapped by Bedrock_Lines) Lines (with GEMS_FeatureClass = 'ContactsAndFaults') Units (dissolved units to make map boundary)	ContactsAndFaults
Points	Stations
Points_Labels_Symbol (with GEMS_FeatureClass = 'OrientationPoints')	OrientationPoints
Points_Labels_Symbol (with GEMS_FeatureClass = 'GeologicPoints')	GeologicPoints
Units_Labels Line_Features_Labels Miscellaneous_Points (SYMBOLOGY <> 'Geochronology point')	GenericPoints
Line_Features (GEMS_FeatureClass = 'GeologicLines')	GeologicLines
Line_Features (GEMS_FeatureClass = 'CartographicLines') Leaders	CartographicLines
Units (SYMBOLOGY_OVERLAY IS NOT NULL)	MapUnitOverlayPolys
Overlay_Polygons	OverlayPolys
Quadrangle_Split_Authors	DataSourcePolys
tbl_Publications	MiscellaneousMapInformation
XSection_Units	CSXMapUnitPolys
XSection_Lines (with GEMS_FeatureClass = 'CSXContactsAndFaults')	CSXContactsAndFaults
XSection_Overlay_Polygons	CSXOverlayPolys
XSection_Lines (with GEMS_FeatureClass = 'CSXCartographicLines') XSection_Leaders	CSXCartographicLines
XSection_Lines (with GEMS_FeatureClass = 'CSXGeologicLines')	CSXGeologicLines
XSection_Labels XSection_Miscellaneous_Points	CSXGenericPoints

Data Mapping

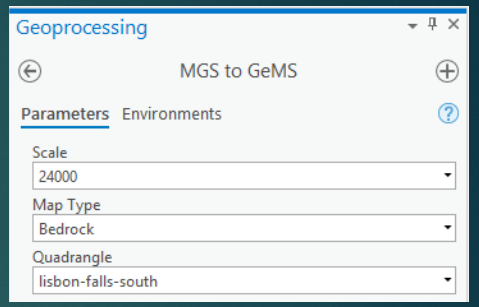
Individual feature types in existing MGS feature classes can be mapped to their GeMS destination feature class using the GeMS:Feature Class field in the MGS Map Explanation table.



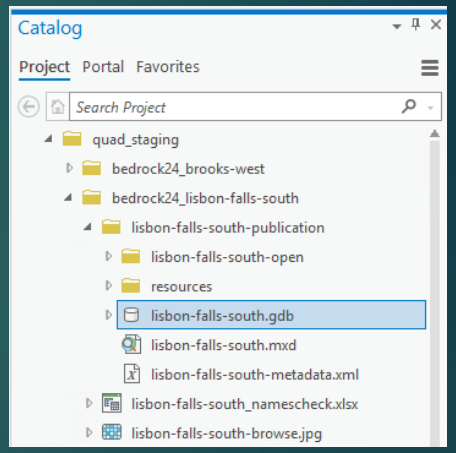
Example of different feature types in a single MGS feature class being mapped to two different GeMS feature classes.

Automated Data Migration

A custom Python tool in an MGS ArcPro toolbox :



- calls a SQL Server database stored procedure that
  - truncates (deletes) any existing data in each of the staging tables/feature classes
  - loads data to each of the staging tables and feature classes for the selected quadrangle, scale (24K or 100K), and map type (bedrock or surficial)
- creates the GeMS submission fgdb in a staging folder
- copies the staged GeMS data to the fgdb



This provides the flexibility to create GeMS submissions for any map published by MGS.

Automated Data Migration

SQL Server database stored procedure: uspGEMS_Stage_Data

355 SELECT statements from MGS data to create 22 GeMS feature classes/tables

~3200 lines of code

YIKES!!!

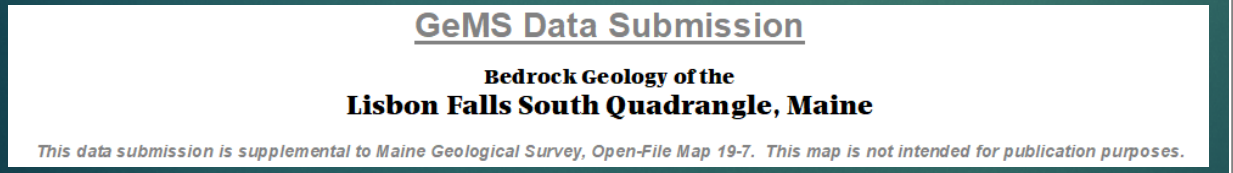
```
--##---MapUnitPolys----------------------------------------------------------------------------
TRUNCATE TABLE GEMS_MapUnitPolys;
INSERT INTO GEMS_MapUnitPolys
SELECT CAST(ROW_NUMBER() OVER (ORDER BY QUADNAME, Map, Scale) as int) AS OBJECTID
    ,[MapUnit]
    ,[IdentityConfidence]
    ,[Label]
    ,[Symbol]
    ,[DataSourceID]
    ,[Notes]
    ,[MapUnitPolys_ID]
    ,[Shape]
    ,[Symbol_MGS]
FROM (
    --Bedrock 24K
    SELECT
        REPLACE(REPLACE(REPLACE(REPLACE(REPLACE(REPLACE(UNIT,'C#','C'),'T#','T'),'M#','M'),'P#','P'),'Cz#','Cz'),'Pz#','Pz')
            --'C#'=cambrian, 'T#'=triassic, 'M#'=mesozoic, 'P#'=pennsylvanian, 'Cz#'=cenozoic 'Pz#'=paleozoic
          AS MapUnit
        ,IDENTITY_CONFIDENCE AS IdentityConfidence
        ,UNIT AS Label
        ,CAST(tbl_GEMS_Colors_MGS_to_FGDC.FGDC_Color AS nvarchar(50)) AS Symbol
        ,SYMBOLOGY AS Symbol_MGS
        ,(SELECT DataSources_ID FROM GEMS_DataSources WHERE SOURCE = 'this report') AS DataSourceID
        ,GEMS_NOTES AS Notes
        ,'MUP' + CAST(Bedrock_Units_evw.OBJECTID AS nvarchar(10)) AS MapUnitPolys_ID  --COMPID??
        ,SHAPE
        ,Bedrock_Units_evw.QUADNAME
        ,'Bedrock' AS Map
        ,'24000' AS Scale
    FROM Bedrock_Units_evw
        JOIN tbl_GEMS_Colors_MGS_to_FGDC ON Bedrock_Units_evw.SYMBOLOGY = tbl_GEMS_Colors_MGS_to_FGDC.ColorName
    WHERE Bedrock_Units_evw.QUADNAME = @Quad

    --Surficial 24K
    UNION ALL
    SELECT
        UNIT AS MapUnit
        ,IDENTITY_CONFIDENCE AS IdentityConfidence
        ,UNIT AS Label
        ,CAST(tbl_GEMS_Colors_MGS_to_FGDC.FGDC_Color AS nvarchar(50)) AS Symbol
        ,UNIT AS Symbol_MGS
        ,(SELECT DataSources_ID FROM GEMS_DataSources WHERE SOURCE = 'this report') AS DataSourceID
        ,GEMS_NOTES AS Notes
        ,'MUP' + CAST(Surficial_Geology_Units_evw.OBJECTID AS nvarchar(10)) AS MapUnitPolys_ID  --COMPID??
        ,SHAPE
        ,Surficial_Geology_Units_evw.QUADNAME
        ,'Surficial' AS Map
        ,'24000' AS Scale
    FROM Surficial_Geology_Units_evw
        JOIN tbl_GEMS_Colors_MGS_to_FGDC ON Surficial_Geology_Units_evw.UNIT = tbl_GEMS_Colors_MGS_to_FGDC.ColorName
    WHERE Surficial_Geology_Units_evw.QUADNAME  = @Quad

    --Bedrock 100K
    UNION ALL
    SELECT
        REPLACE(REPLACE(REPLACE(REPLACE(REPLACE(REPLACE(UNIT,'C#','C'),'T#','T'),'M#','M'),'P#','P'),'Cz#','Cz'),'Pz#','Pz')
            --'C#'=cambrian, 'T#'=triassic, 'M#'=mesozoic, 'P#'=pennsylvanian, 'Cz#'=cenozoic 'Pz#'=paleozoic
          AS MapUnit
        ,IDENTITY_CONFIDENCE AS IdentityConfidence
        ,UNIT AS Label
        ,CAST(tbl_GEMS_Colors_MGS_to_FGDC.FGDC_Color AS nvarchar(50)) AS Symbol
        ,SYMBOLOGY AS Symbol_MGS
        ,(SELECT DataSources_ID FROM GEMS_DataSources WHERE SOURCE = 'this report') AS DataSourceID
        ,GEMS_NOTES AS Notes
        ,'MUP' + CAST(Bedrock_100K_Units_evw.OBJECTID AS nvarchar(10)) AS MapUnitPolys_ID  --COMPID??
        ,SHAPE
        ,Bedrock_100K_Units_evw.QUADNAME
        ,'Bedrock' AS Map
        ,'100000' AS Scale
    FROM Bedrock_100K_Units_evw
        JOIN tbl_GEMS_Colors_MGS_to_FGDC ON Bedrock_100K_Units_evw.SYMBOLOGY = tbl_GEMS_Colors_MGS_to_FGDC.ColorName
    WHERE Bedrock_100K_Units_evw.QUADNAME = @Quad
```

Manual Steps

Run GeMS Tools manually:

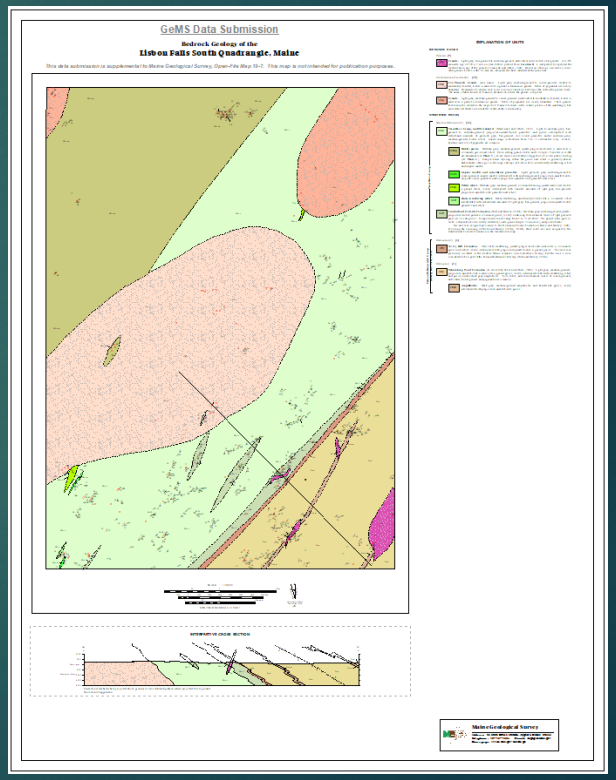
- Load default file geodatabase metadata and edit
- Run Validate Database tool and deal with any errors
- Run Geologic Names Check tool
- Run Metadata 1, 2, and 3 tools
- Run Translate to Shapefiles tool

Build GeMS submission map document which is not the same as the original map document


GeMS Data Submission

Bedrock Geology of the
Lisbon Falls South Quadrangle, Maine

This data submission is supplemental to Maine Geological Survey, Open-File Map 19-7. This map is not intended for publication purposes.



GeMS Submission Package

Manually compile all the components of the GeMS Package

- Original map PDF
- ArcMap document (not original – GeMS data only)
- Export map photos, text, figures, tables
- Collect style and font files
- Transmittal letter
- Map browse graphic

Create zip file

Post and notify NGMDB

Next Steps/Improvements

Metadata tools needed for ArcPro

Incorporate Validate Database into SQL Server db

Script gathering of resource (map photos, figures, tables, and text), map document, and graphic files

Script running of GeMS tools in a batch or in database

Script cleanup of intermediate validation and metadata files

Script building GeMS map document

Accomplishments

- Costs quantified
  - 8-12 hours for author geologist to review and complete GeMS data entry on a published quadrangle (longer if not the author)
  - 4-8 hours for data manager to compile GeMS Submission package
- Staff trained
- GeMS submission process fully documented
- MGS to GeMS translation logic centralized in MGS database
- Three Level 3 and one Level 1 GeMS packages successfully submitted in May 2021.

Questions?

Thanks!