Hydrogeologic Tables Data Dictionary

Hydrogeologic Tables Related to a Geologic Map Unit Feature Class:

- **HYDROGEOLOGIC_UNIT_TBL**
- **AQUIFER_VULNERNABILITY_TBL**
- **GEOLOGIC MAP UNIT FEATURE CLASS ATTRIBUTE TABLE**

Abstract

The tables defined in this data dictionary link (relate) to the feature attribute table of a geologic map unit feature class representing an area of interest. The combination of linked tables linked to the feature class helps geologists and hydrologists identify and map hydrogeologic units as aquifers or confining units and identify and map aquifers vulnerable to contamination. Identification of hydrogeologic units and vulnerable aquifers is the starting point for conducting analyses of groundwater flow in an area of interest. A hydrogeologic link field is added to the feature class to create table relationships.

The lithology of geologic map units can change laterally such that a coarse-grained aquifer in one area may give way to a fine-grained confining unit in another area. For this reason, hydrogeologic characterizations should not be applied over extents larger than is appropriate to a specific geologic context. Similarly, merging hydrogeologic units over broad extents is not recommended.

The approach of using related tables allows the use of the best available geologic map unit feature class whether it resides in the Natural Resource Manager (NRM), Enterprise Data Warehouse (EDW), unit Spatial Database Engine (SDE) schema, or within a non-Forest Service organization such as the United States Geological Survey (USGS), state geological survey, or academic institution. It is recommended that the linking field(s) be added to a copy or portion of a geologic map unit feature class representing the area of interest. The original feature class would remain unchanged to avoid having to modify corporate standards for such features classes and to avoid inappropriate application beyond the extent of the area of interest or project area.

The typical workflow to identify hydrogeologic units and vulnerable aquifers involves the following steps:

1) **Define Hydrogeologic Map Units** in the HYDROGEOLOGIC_UNIT_TBL table.
    a. Build or use an example table as a template to create the table.
    b. Use known hydrogeologic characteristics from geologic map units to define Hydrogeologic units in the table. List the component geologic map units for each hydrogeologic unit in the table to aid in selecting and assigning these units to geologic map units in the feature class and aquifer vulnerability table.
    c. Assign a HYDROGEO_LINK field in the HYDROGEOLOGIC_UNIT_TBL to each hydrogeologic unit that will be linked/related to other tables.
2) **Prepare Geologic Map Unit Feature Class**.
    a. Add linking fields to a geologic unit feature class that represents the geology of a project area.
    b. Assign the HYDROGEO_LINK values to the appropriate geologic map units identified HYDROGEOLOGIC_UNIT_TBL. This is best done by selecting groups of appropriate records to modify or calculate values.
3) **Characterize Aquifer Vulnerability** in the AQUIFER_VULNERNABILITY_TBL table.
    a. Build or use an example table as a template to create the table.
    b. Conduct populate the table as needed to characterize aquifer vulnerability. The recommended DRASTIC Model is described below.

4) **Relate Tables**. Relate hydrogeologic units in the HYDROGEOLOGIC_UNIT_TBL to the Geologic Map Unit Feature class and AQUIFER_VULNERNABILITY_TBL table using the HYDROGEO_LINK field within a relationship class or ARCMAP relate.

Once these relationships have been established, hydrogeologic units and vulnerable aquifers can be selected and symbolized from the geologic map unit feature class for mapping and further analysis.

Description

Hydrogeologic tables to be related to geologic map unit feature classes.

Reference

Groundwater Inventory, Monitoring, and Assessment (IM&A) Technical Guide V 1.0

Spatial Data Source

The geologic map unit feature classes are typically derived from state or Federal geologic maps, but may come from other sources such as university or Forest Service mapping efforts.

Horizontal Accuracy

Horizontal accuracy depends varies depending on the source of the specific geologic Map Unit feature classes. In general, the geospatial positioning accuracy of geospatial datasets produced during a mapping project must be calculated according to the standard defined in Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy (FGDC-STD-007.3-1998; FGDC 1998).

Horizontal accuracy standards by map level, map scale, horizontal accuracy:
National, 1:1,000,000, ± 1666 ft
Broad, 1:250,000, ± 416 ft
Mid, 1:100,000, ± 166 ft
Base, 1:24,000, ± 40 ft

Spatial Reference Information

Spatial Reference depends on geologic map unit feature classes used. Projection must be defined. Datum should be NAD83 or equivalent.

Feature Type

Used with Polygon geologic map unit feature classes.

Keywords

Geology, lithology, stratigraphy, geomorphology, aquifer, confining unit, DRASTIC, hydrogeology, aquifer vulnerability

Use Constraints

The Forest Service uses the most current and complete data available. GIS data and products accuracy may vary. They may be developed from sources of differing accuracy, such as the data or product may be accurate only at certain scales, based on modeling or interpretation, or incomplete while being created or revised. Using GIS products for purposes other than those for which they were created may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify, or replace GIS products without notification.

HYDROGEOLOGIC_UNIT_TBL. This table is used to reclassify groups of geologic map units into Hydrogeologic Units and identify them as specific aquifers or confining units. Hydrogeologic Units are named and assigned a hydrogeologic link to connect to and symbolize a geologic map unit feature class through the HYDROGEO_LINK_TBL table.

Hydrogeologic Units correspond to figures 2-1 (Legend) and 2-2 (Map of the Fishlake NF) in section 2.2.1 of the Groundwater Inventory, Monitoring, and Assessment Technical Guide (v1.0).

HYDROGEOLOGIC_UNIT_TBL Schema

Name	Recommended or Optional (R or O)	Type	Length	Precision, Scale
OBJECTID		Text *2		
MAP_UNIT_SYMBOL*1	O	Text	20	
PROJECT_CODE*1	O	Text	10	
MAP_SCALE*1	O	SmallInteger *2	2	3
AQUIFER_CHARACTER	R	Text	15	
HYDROGEOLOGIC_UNIT	R	Text	150	
HYDROGEO_LINK	R	Text	50	
AQUIFER_MEDIA*3	O	Long Text	1000	
HYDROGEOLOGIC_PROPERTIES *3	O	Long Text	1000	
NOTES	O	Text	300	
MAP_UNIT_SYMBOL_500	O	Text	150	
MAP_UNIT_SYMBOL_100	O	Text	150	
MAP_UNIT_SYMBOL_24	O	Text	150	
MAP_UNIT_SYMBOL_OTHER	O	Text	150	

*1- Generated by scripts to create HYDROGEOLOGIC_***UNIT_TBL from Geologic Map Unit feature class.***

*2 Smallinteger and short integer are synonymous as are Text and String.

*3 - The capacity of Long Text fields exceeds 1000 characters, but it is recommended the text not exceed 1000 characters for readability.

Attribute Field Description and Domains, HYDROGEOLOGIC_UNIT_TBL

HYDROGEOLOGIC_UNIT_TBL

ITEM NAME: HYDROGEOLOGIC_UNIT

Named grouping of Geologic units reclassified as hydrogeologic units representing specific aquifers or confining units. Both Code and Description are the same to ensure the code shows in the table. Examples are shown below.

CODE	DESCRIPTION
Triassic Aquitard (Chinle/Moenkopi Confining Unit)	Triassic Aquitard (Chinle/Moenkopi Confining Unit)
Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)	Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)

HYDROGEOLOGIC_UNIT_TBL		
ITEM NAME: AQUIFER_CHARACTER		
Represents the hydrogeologic unit as a confining unit, aquifer, or unknown. A geodatabase domain facilitates populating this field. The domain is shown below.		
CODE	**DESCRIPTION**	**DEFINITION**
Confining Unit	Confining unit	Geologic unit that restricts or prevents ground water movement
Aquifer	Aquifer	Geologic unit capable of storing water.
Unknown	unknown	Aquifer characteristics unknown

HYDROGEOLOGIC_UNIT_TBL
ITEM NAME: AQUIFER_MEDIA
Describes the lithology of the aquifer. See figure 2-1 from section 2.2.1 of the Groundwater IM&A Tech Guide, shown below for examples.

HYDROGEOLOGIC_UNIT_TBL
ITEM NAME: HYDROGEOLOGIC_PROPERTIES
Describes the hydrogeologic properties of the hydrogeologic unit such as permeability, dissolved solids, and importance. An example of a hydrogeologic unit table that describes these types of properties is figure 2-1 from section 2.2.1 of the Groundwater IM&A Tech Guide.

HYDROGEOLOGIC_UNIT_TBL
ITEM NAME: NOTES
Comment field to provide additional explanation about ~~with~~ the hydrogeologic unit.

HYDROGEOLOGIC_UNIT_TBL	
ITEM NAME: MAP_UNIT_SYMBOL_24, MAP_UNIT_SYMBOL_100, MAP_UNIT_SYMBOL_250, MAP_UNIT_SYMBOL_500, MAP_UNIT_SYMBOL_OTHER	
The component geologic map units for each hydrogeologic unit can be listed by map scale here. These fields function as a worksheet to aid in selecting geologic map units and assigning hydrogeologic units through the HYDROGEO_LINK_TBL table and HYDROGEO_LINK field. 500 means 1:500,000; 100 means 1:100,000, 24 means 1:24,000. Examples are shown below.	
MAP_UNIT_SYMBOL_500	MAP_UNIT_SYMBOL_100
Tr1, Tr2	TRm, TRc, TRcl, TRcm, TRcs, TRcu, @Pmc, TRw, TRt, TRa

HYDROGEOLOGIC_UNIT_TBL		
ITEM NAME: HYDROGEO_LINK		
Coded symbol for a hydro-geologic unit defined for each mapping project. Creation of a geodatabase domain from the HYDROGEOLOGIC_UNIT_TBL table may facilitate populating this field. Both Code and Description are the same to ensure the code shows in the table. Examples are shown below.		
CODE	**DESCRIPTION**	**Definition**
hg16	hg16	Triassic Aquitard (Chinle/Moenkopi Confining Unit)
hg15	hg15	Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)

Figure 1: Figure 2-1 from section 2.2.1, Hydrogeologic Mapping, in the Groundwater IM&A Tech Guide.

Hydrogeologic Map Unit	Symbol	Aquifer media	Hydrogeologic properties
Quaternary Alluvium	Qa	Youngest alluvium in the channels, floodplains, and adjacent low terraces of rivers and streams; consists of sand, silt, and clay with lenses of gravel; mostly 0-6 m thick, but may be thicker locally.	Shallow water table. Generally unconfined. A local aquifer where saturated. Supports riparian habitats along streams. May be hydrologically connected to streams.
Quaternary-Tertiary Alluvium	Qao, QT	Poorly sorted silt, sand, and pebble, cobble, and boulder gravel deposited by streams, sheetwash, debris flows, and flash floods on alluvial fans, and in canyons and mountain valleys; generally 0-18 m thick but can be up to 60 m.	Deep water table. A local aquifer where saturated. Generally unconfined but could be locally perched or confined.
Tertiary Intrusives	Ti	Quartz monzonite and granite	The hydrogeologic characteristics of these rocks vary with the degree of fracturing. Generally impermeable and make poor aquifers.
Tertiary Extrusives Lava	Tmv, Tpb, Tmb, Tpr	Basalt and andesite lava flows, pyroclastic rocks mainly on the Sevier Plateau and southeastern part of the Palvant Range.	Highly varible hydrogeologic characteristics. Basalt flows can form highly productive aquifers. Tuffs tend to be less permeable.
Tertiary Extrusives Breccias	Tov	Andesite breccias of the Bullion Canyon volcanics: massive mudflow breccias, pebble to boulder size andesite, rhyodacite, and quartz latite lava flows, includes layers of fluvial sandstone and conglomerate; mostly on the Sevier Plateau and southeast part of the Palvant Range; up to 760 m thick.	Highly permeable and can form productive aquifers where saturated.
Tertiary Sedimentary Aquifers	T5, T4, T3, T2, T1	Sevier River Fm (T5): poorly to moderately consolidated fluviatile and lacustrine conglomerate, sandstone and siltstone with layers of tuff and basaltic lava flows, 180-300 m. Oak City Formation (T4): sandy, bouldery gravel; poorly to well cemented; forms dissected alluvial apron on west side of Palvant Range and Canyon Mountains; estimated thickness as much as 600 m. Crazy Hollow Fm (T3): sandstone, siltstone,and shale; 0-100 m. Green River Fm (T2): shale overlain by sandy limestone, sandstone, and bentonite tuff, 0-245 m. Flagstaff Ls (T1): interbedded, limestone, sandstone, siltstone, mudstone, and conglomerate; size and percentage of clastic material generally increase westward, 0-1000 m.	Where present on forest, permeability from fractures and primary porosity. Permeable units interfingered and interbedded with confining units. Contains locally productive aquifers where saturated.
Cretaceous Sedimentary Aquifers (Mesaverde Aquifer)	TK, K3	North Horn Fm (TK): sandstone with interbeds of siltstone, mudstone, conglomerate, and limestone; proportion of conglomerate decreases eastward; maximum thickness is in northern Canyon Mountains, where it is more than 1,200 m thick. Mesaverde Gp (K3): conglomerate and some interlayered sandstone and siltstone beds, becoming more conglomeratic westward, variable thickness. In the Canyon Mountains and Palvant Range this is mapped as upper Canyon Range Conglomerate; 140 to 275 m thick. In the east mapped as Price River Fm, Castlegate Sandstone, Blackhawk Fm., and Star Point Sandstone.	Mesaverde Aquifer, western edge of a major regional aquifer. Permeability from fractures and primary porosity. Permeable units are interfingered and interbedded with confining units. Dissolved solids range from 1000 to 4000 mg/L. This formation are very coarse-grained (conglomerate) in Palvant Range and finer -grained with interbedded mudstone in eastern part of forest (Sevier Plateau). The transition is in Valley Mounatins and San Pitch Mountains.
Cretaceous Sedimentary Aquitards/Aquifers (Mancos Confining Unit)	K2	Indianola Group/Canyon Range Conglomerate in the Canyon Range and Mancos Shale on eastern edge of forest: massive, well cemented conglomerate; 2500-4500 m characterize the Indianola Gp. In the west grading to fine-grained sandstone and interbedded mudstone of the Mancos Shale in the east. In the Canyon Mountains and Palvant Range, Indianalo Gp. is 1300 to as much as 2600 m thick, Mancos Shale is 600 to 1000 m thick.	Comprised of several formations that are aquifers and confining units. These formation are very coarse-grained (conglomerate) in wetern part of the forest (Canyon Mountains-Palvant Range) and finer -grained with mudstone and coal in eastern part of forest (Sevier Plateau). The transition is in Valley Mounatins and San Pitch Mountains area. The coarse-grained western units will likely have low dissolved solids even at depths greater than 600 m; the eastern fine-grained units will likely have greater disolved solids at depth; the eastern units are oil and gas reservoirs.
Cretaceous Sedimentary Aquifer (Dakota Aquifer)	K1	Present as Dakota Sandstone on east edge of the Forest: Sandstone, carbonaceous shale, and some coal; sandstone is thick bedded, fine- to coarse-grained becoming more conglomeratic westward. Included in the lower Canyon Range Conglomerate in the Canyon Mountains and Palvant Range; 6 to 30 m in east becoming as much as 250 m in the west.	The conglomeratic lithofacies in the west part of the forest (Canyon Mountains-Palvant Range) will likely have low dissolved solids even at depths greater than 600 m; the eastern fine-grained units will likely have greater disolved solids at depth; also considered an oil and gas reservoir.
Upper Jurassic Sedimentary Aquitard (Morrison Confining Unit)	J2	Morrison Fm: Clay-rich mudstone and thin interbedded coarse-grained sandstone; about 0 to 140 m thick	Aquitard. only outcrops on eastern edge of forest (Sevier-Wasatch Plateaus).
Middle Jurassic Sedimentary Aquitard/Aquifer	J1	Exposed on southeast edge of forest. Curtis Fm: silty sandstone and mudstone; Entrada Sandstone: fine-grained sandstone; the middle Jurassic stratigraphic succession is partially preserved under Canyon Mountains and Palvant Range at depths greater than 3000 m and fully preserved at depths between 2100 to 4600 m to the east.	Confining units interlayered with potential local aquifers in sandstone and limestone units; where present the Entrada sandstone is an aquifer.
Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)	Jg	In Pavant Range - Navaho Sandstone: fine-grained cross-bedded sandstone, 600 m thick. On southeast side of Forest - Navajo Sandstone-Kayenta Fm-Wingate Sandstone: Navajo and Wingate are massive, fine-grained sandstones; Kayenta Fm is shale and siltstone with interbedded sandstone; Glen Canyon Gp. is 180 to 370 m thick.	These formations comprise the western edge of the major regional Glen Canyon aquifer. Likely has low disolved solids in the Palvant Range and higher dissolved solids in Canyon Mountains and Sevier-Wasatch Plateaus. It is a major oil reservoir in the region.
Moenkopi-Chinle Fm Aquitard	Tr1, Tr2	Siltstone, sandstone, shale, and minor limestone; 300-600 m thick.	Confining unit between the Glen Canyon and Coconino-DeChelly Aquifers.
Paleozoic Sedimentary Aquifer (Coconino-DeChelly Aquifer)	P2, P1, PP, M1, D, S, O	Kaibab Limestone (P2), Pakoon Dolomite (P1), Calville Limestone (PP), Redwall Limestome (M1), Devonian carbonates (D), Silurian dolomite (S), and Ordovician carbonates (O). Exposed in the Canyon Mountains and Palvant Range along the Pavant thrust and Red Ridge thrust foot wall. They are not preserved eastward in the Sevier Valley and Sevier-Wasatch Pleatues. Interval thickness ranges from about 1000 m thick in west thining to about 580 m thick in east.	Western part of the regional Coconino-DeChelly Aquifer of the Colorado Plateau. Permeability from fractures and primary porosity in sandstones and fractures and solution channels in limestones. Generally will have high dissolved solids and are considered oil and gas reservoirs.
Cambrian Limestone Aquifer	C2, C3	Limestone and dolomite: C3 includes Ajax Dolomite and Opex Fm. C2 includes Cole Canyon and Bluebird Dolomites, Herkimer, Dagmar and Teutonic Fms, and Ophir Fm.	Permeability from fractures; may be locally karstic; contains locally productive aquifers where saturated. Generally will have high dissolved solids and are considered oil and gas reservoirs.
Cambrian and Precambrian Metasedimentary Aquifer	C1, PCs	Prospect Mountain and Tintic Quartzite (C1): fine-grained to pebbly, vitreous quartzite. Tintic Quartzite is exposed in the Canyon Mountains and Palvant Range and in the subsurface to the east at depths approaching 6,000 m; thins eastward; Precambrian strata (PCs): Other metasedimentary rocks exposed in the Canyon Mountains and likely at great depths eastward; mainly composed of quartzite and phyllitic shale; includes Mutual Fm, Inkom Fm, Caddy Canyon Quartzite, Blackrock Canyon Limestone, and Pocatello Fm.	Permeability from fractures; contains locally productive aquifers where saturated; potential aquifer in the Canyon Mountains and Palvant Range.
Water			

AQUIFER_VULNERABILITY_TBL. This table rates aquifers from the HYDROGEOLOGICUNIT_TBL as to their vulnerability for contamination using the DRASTIC model. The VUNERABILITY_INDEX rates relative vulnerability. The table also contains the hydrogeologic link used to connect to and symbolize a geologic map unit feature class.

The DRASTIC model is widely used to evaluate aquifer vulnerability. It is named for the seven factors considered in the method: Depth to water, net Recharge, Aquifer media, Soil media, Topography, Impact of vadose zone media, and hydraulic Conductivity of the aquifer (Aller et al. 1985).

Used in conjunction with geologic map unit feature class, this table implements the Beaverhead-Deerlodge National Forest approach described in appendix 4-A of the Groundwater IM&A Technical Guide. This data dictionary follows that approach. An alternative method puts the seven DRASTIC factors into a GIS analysis following the Pawnee National Grasslands example, also in appendix 4-A.

Data are typically entered manually into the table. The vulnerability index can be entered manually or calculated from the seven factors. Table 4-A-1 from Groundwater IM&A Technical Guide shows typical values used in the DRASTIC model.

AQUIFER_VUNERABILITY_TBL Schema

Name	Recommended or Optional (R or O)	Type	Length	Precision, Scale
OBJECTID	R			
VULNERABILITY_INDEX	R	SmallInteger	2	3
AQUIFER_MEDIA	O	Text	150	
AQUIFER_MEDIA_RATING	O	SmallInteger	2	2
DEPTH_TO_WATER_FT	O	Text	50	
DEPTH_TO_WATER_RATING	O	SmallInteger	2	2
RECHARGE_INCHES	O	Text	50	
RECHARGE _RATING	O	SmallInteger	2	2
SOIL_TEXTURE	O	Text	150	
SOIL_TEXTURE_RATING	O	SmallInteger	2	2
SLOPE_PERCENT	O	Text	50	
SLOPE_PERCENT_RATING	O	SmallInteger	2	2
VADOSE_ZONE_MEDIA	O	Text	150	
VADOSE_ZONE_MEDIA_RATING	O	SmallInteger	2	2
K_CONDUCTIVITY_GPD_CFT	O	Text	50	
K_CONDUCTIVITY_RATING	O	SmallInteger	2	2
HYDROGEO_LINK	R	Text	50	

Figure 2: Table 4-A1. – DRASTIC computation matrix showing methods for computing index values for various hydrogeological settings, Pioneer Mountains, Montana.

Map units	DRASTIC Index	Aquifer media	*Rating*	Depth to water (ft)	*Rating*	Recharge (in)	*Rating*	Soil	*Rating*	Topography (% Slope)	*Rating*	Vadose zone	*Rating*	K (gpd/ft²)	*Rating*
Qo	180	glacial outwash	*8*	5-15	*9*	4-7	*6*	gravel	*10*	2-6	*9*	sand & gravel (s & g)	*8*	700-1000	*6*
Qm	124	glacial till	*5*	15-30	*7*	4-7	*6*	sandy loam	*6*	6-12	*5*	s & g with silt and clay	*6*	1-100	*1*
Ql	130	landslide	*8*	50-75	*3*	7-10	*8*	silty loam	*4*	2-6	*9*	s & g with silt and clay	*6*	300-700	*4*
Qf	160	alluvial fan	*8*	30-50	*5*	7-10	*8*	sandy loam	*6*	2-6	*9*	s & g	*8*	700-1000	*6*
Qtg, Tbz	134	alluvial gravels, Bozeman group	*8*	30-50	*5*	7-10	*8*	silty loam	*4*	2-6	*9*	s & g with silt and clay	*6*	100-300	*2*
Ym, Ymm, Kbgg, Kgtd Tkg	65	metamorphic igneous (east slopes)	*3*	100+	*1*	0-2	*1*	thin or absent	*10*	18+	*1*	metamorphic igneous	*4*	100-300	*2*
Cu, Kk, Ks	70	metamorphic igneous (west slopes)	*3*	75-100	*2*	0-2	*1*	thin or absent	*10*	18+	*1*	metamorphic igneous	*4*	100-300	*2*
Pmu, IPmu, Pp	83	bedded ss, ls, sh sequences (east slopes)	*6*	75-100	*2*	0-2	*1*	sandy loam	*6*	12-18	*3*	ss. ls, sh	*6*	100-300	*2*
Tc, Tvu, Tru	106	bedded ss, ls, sh sequences (east slopes)	*6*	30-50	*5*	2-4	*3*	sandy loam	*6*	12-18	*3*	ss. ls, sh	*6*	100-300	*2*
Madison Ls	142	limestone	*9*	100+	*1*	4-7	*6*	silty loam	*4*	12-18	*3*	ls	*9*	1000-2000	*10*

*Map Units: Qo - Quaternary glacial outwash; Qm - Quaternary glacial moraine; Ql - Quaternary landslide deposits; Qf - Quaternary alluvial fan; Qtg - Quaternary alluvial gravels; Tbz - Tertiary Bozeman group; Ym - Precambrian Missoula group; Ymm - Precambrian Missoula group; Kbgg - Cretacious biotite grandiorite and granite; Kgtd - Cretacious granite and diabase; Tkg - Tertiary-Cretacious granite; Cu - Precambrian Cherry Creek series; Kk - Cretacious Kootenai Fm; Ks - Cretacious sediments, undifferentiated; Pmu - Permian, undifferentiated; IPmu - Triassic Permian, undifferentiated; Pp - Permian Phosphoria Fm; Tc - Tertiarycolluvium; Tvu - Tertiary volcanics, undivided; Tru - volcanics, undifferentiated; Mmm - Mississippian Madison Mission Canyon Fm.

AQUIFER_VUNERABILITY TABLE - DOMAIN AND FIELD DESCRIPTION

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: VULNERABILITY_INDEX
This is the overall rating of aquifer vulnerability. This can be a subjective rating of High, Medium, or Low vulnerability or calculated using the DRASTIC Method. The fields need to use the DRASTIC Method have been provided. This index must be consistent across a mapping project. Refer to section 4.2, Groundwater Evaluation and Assessment Methods, Assessment of Groundwater Vulnerability in the Groundwater IM&A Technical Guide.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: AQUIFER_MEDIA
Refers to the saturated zone material properties that control the pollutant attenuation processes.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: DEPTH_TO_WATER_FT
Represents the depth from the ground surface to the water table. Deeper water table levels imply less chance for contamination to occur.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: RECHARGE_INCHES
Represents the amount of water that penetrates the ground surface and reaches the water table; recharge water represents the vehicle for transporting pollutants. This is a range of values.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: SOIL_TEXTURE
Represents the uppermost weathered portion of the unsaturated zone and controls the amount of recharge that can infiltrate downward.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: SLOPE_PERCENT
Refers to the slope of the land surface; it dictates whether the runoff will remain on the surface to allow contaminant percolation to the saturated zone. It is usually a slope range.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: VADOSE_ZONE_MEDIA
Describes the unsaturated zone material which controls the passage and attenuation of the contaminated material to the saturated zone.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: K_CONDUCTIVITY_GPD_CFT
Indicates the ability of the aquifer to transmit water which determines the rate of flow of contaminant material within the groundwater system. Measured as gallons per day per cubic foot.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: AQUIFER_MEDIA_RATING, DEPTH_TO_WATER_RATING, RECHARGE_RATING, SLOPE_PERCENT_RATING, SOIL_TEXTURE_RATING, VADOSE_ZONE_MEDIA_RATING, K_CONDUCTIVITY_RATING
Relative rating for each of the factors included in the DRASTIC Model.

Domain Tables, AQUIFER_VULNERABILITY_TBL
ITEM NAME: HYDROGEO_LINK
Link used to relate hydrogeology and aquifer vulnerability tables to geology map unit feature classes.

GEOLOGIC MAP UNIT FEATURE CLASS feature attribute table. This is the feature attribute table for the geologic map unit feature class used to for a project area or area of interest.

Attributes added to this table facilitate symbolization of hydrogeologic units and aquifer vulnerability. Relating the HYDROGEOLOGIC_UNIT_TBL and AQUIFER_VUNERABILITY_TBL tables to the feature class is accomplished through the HYDROGEO_LINK field. Relationships can be made manually in ARCMAP or by creating relationship classes. Fields representing Geologic map unit symbol and name should already exist in the feature class.

When combining data from different geologic map sources, be sure the hydrogeologic characteristics are the same. The project code field has been supplied to help differentiate map sources during selection of features to receive a HYDROGEO_LINK value.

OBJECTID *	MAP_UNIT_SYMBOL	PROJECT_CODE
47	TKsz	ABAJO31K
48	TRc	ABAJO31K
49	TRc	LASALGEO
50	TRcl	ABAJO31K
51	TRcm	ABAJO31K
52	TRcs	ABAJO31K
53	TRcu	ABAJO31K
54	TRk	ABAJO31K
55	TRm	ABAJO31K
56	TRm	LASALGEO
57	TRu	ABAJO31K
58	TRw	ABAJO31K

Typically, the ***HYDROGEOLOGIC_UNIT_TBL*** will be created before populating HYDROGEO_LINK field in the feature class. Some practioners may choose to define Hydrogeolgic Units directly within the feature class. For that reason, the MAP_SCALE, AQUIFER_CHARACTER and HYDROGEOLOGIC_UNIT fields have been provided. If done in this way, the **HYDROGEOLOGIC_UNIT_TBL** table could be created in part from the feature class. (See ***Method for creating HYDROGEO_LINK TABLE from a Geologic Map Unit feature class attribute table*** below). These fields are primarily intended to facilitate this approach and would not needed if Hydrogeologic Units have already been defined in the ***HYDROGEOLOGIC_UNIT_TBL.***

Schema for Fields to be added to the Geologic Map Unit feature class

Name	**Recommended or Optional (R or O)**	**Type**	**Length**	**Precision, Scale**
OBJECTID				
PROJECT_CODE*1	R	Text	10	
MAP_SCALE*2	R	SmallInteger	2	3
AQUIFER_CHARACTER*2	R	Text	15	
HYDROGEOLOGIC_UNIT*2	R	Text	150	
HYDROGEO_LINK	R	Text	50	

*1 - Recommended if the same map unit symbol applies to different mapping projects.

*2 - Used when building the HYDROGEOLOGIC_UNIT_TBL from the HYDROGEO_LINK_TBL.

Attribute Field Description and Domains, HYDROGEO_LINK_TBL

Geologic Map Unit feature class	
ITEM NAME: PROJECT_CODE	
This is the code for a geologic mapping project (map source) from the geologic map unit feature classes. This field is used when more than one mapping project is represented in the feature class. Use of geodatabase domain is not intended. Examples are shown below.	
ATTRIBUTE VALUE	DESCRIPTION
MOABGEO	*Geologic* Map of the *Moab 30' x 60*' Quadrangle.
LASALGEO	*Geologic* Map of the *La Sal 30' x 60*' Quadrangle.

Geologic Map Unit feature class	
ITEM NAME: MAP_SCALE	
This describes the map scale of the geologic map units by project (see PROJECT_CODE). Geologic map units using the same MAP_UNIT_SYMBOL may have been mapped at different scales in different mapping projects. This field is helpful in evaluating the detail of geologic mapping applicable to hydrogeologic units. Creation of a geodatabase domain table may facilitate populating this field. The domain is shown below.	
CODE	DESCRIPTION
12	1:12,000
24	1:24,000
31	1:31,680
50	1:50,000
100	1:100,000
250	1:250,000
500	1:500,000
00	Other map scale

Geologic Map Unit feature class		
ITEM NAME: AQUIFER_CHARACTER		
Represents the hydrogeologic unit as a confining unit, aquifer, or unknown. A geodatabase domain facilitates populating this field. AQUIFER_CHARACTER may be used to facilitate building the HYDROGEOLOGIC_UNIT_TBL. The domain is shown below.		
CODE	**DESCRIPTION**	**DEFINITION**
Confining Unit	Confining unit	Geologic unit that restricts or prevents ground water movement
Aquifer	Aquifer	Geologic unit capable of storing water
Unknown	Unknown	Aquifer characteristics unknown

Geologic Map Unit feature class	
ITEM NAME: HYDROGEOLOGIC_UNIT	
This is the named grouping of Geologic units reclassified as hydrogeologic units representing specific aquifers or confining units. HYDROGEOLOGIC_UNIT may be used to facilitate building the HYDROGEOLOGIC_UNIT_TBL. Both Code and Description are the same to ensure the code shows in the table. Examples are shown below.	
CODE	**DESCRIPTION**
Triassic Aquitard (Chinle/Moenkopi Confining Unit)	Triassic Aquitard (Chinle/Moenkopi Confining Unit)
Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)	Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)

Geologic Map Unit feature class	
ITEM NAME: HYDROGEO_LINK	
Link used to relate hydrogeology and aquifer vulnerability tables to a geology map unit feature class through the HYDROGEO_LINK_TBL. Coded symbol represents a hydrogeologic unit. Creation of a geodatabase domain from the HDYROGEOLOGIC_UNIT_TBL table may facilitate populating this field. To only show the code within ARCGIS, do not use a domain. Examples are shown below.	
CODE	**DESCRIPTION**
hg16	Triassic Aquitard (Chinle/Moenkopi Confining Unit)
hg15	Lower Jurassic Sedimentary Aquifer (Glen Canyon Aquifer)

PYTHON Scripts to Aid in Table Creation

Method for creating HYDROGEO_LINK TABLE from a Geologic Map Unit feature class attribute table

This method creates the HYDROGEOLOGICUNIT_TBL table from the Geologic map unit feature class with the attributes MAP_UNIT_SYMBOL, PROJECT_CODE, MAP_SCALE, HYDROGEOLOGIC_UNIT, AQUIFER_CHARACTER, and HYDROGEO_LINK. It deletes unneeded statistics fields, and adds the remaining fields needed to complete the schema for the table. Modify and paste the scripts below into Python Window in ArcMap. The result may contain repeating records that should be further consolidated so that only one record exists for each Hydrogeologic Unit.

First define the variables MAPU_FC (Map Unit Feature Class) and MAPU_STAT_TBL (map unit statistics table). Then remainder of the python script as is.

Scripts to Define Variables

MAPU_FC="C:/MyWorkspace/MyGeodatabase.gdb/MyMapUnitsFeatureClass"

Example: MAPU_FC="C:/Users/Joe/Desktop/Work/HydrogeologicMap.gdb/Geology"

>>>MAPU_STAT_TBL="C:/MyWorkspace/MyGeodatabase.gdb/HYDROGEOLOGIC_UNIT_TBL"

Example:MAPU_STAT_TBL="C:/Users/Joe/Desktop/Work/HydrogeologicMap.gdb/HYDROGEOLOGIC_UNIT_TBL"

Scripts to create and modify the HYDROGEOLOGIC_UNIT_TBL table

arcpy.Statistics_analysis(MAPU_FC, MAPU_STAT_TBL,[["HYDROGEO_LINK", "COUNT"]],"MAP_UNIT_SYMBOL;PROJECT_CODE; MAP_SCALE;AQUIFER_CHARACTER;HYDROGEOLOGIC_UNIT;HYDROGEO_LINK")

dropFields = ["FREQUENCY", "COUNT_HYDROGEO_LINK"]

arcpy.DeleteField_management(MAPU_STAT_TBL, dropFields)

arcpy.AddField_management(MAPU_STAT_TBL, "AQUIFER_MEDIA", "TEXT", "", "", "1000", "", "NULLABLE", "NON_REQUIRED", "")

arcpy.AddField_management(MAPU_STAT_TBL, "HYDROGEOLOGIC_PROPERTIES", "TEXT", "", "", "1000", "", "NULLABLE", "NON_REQUIRED", "")

arcpy.AddField_management(MAPU_STAT_TBL, "NOTES", "TEXT", "", "", "300", "", "NULLABLE", "NON_REQUIRED", "")

arcpy.AddField_management(MAPU_STAT_TBL, "MAP_UNIT_SYMBOL_500", "TEXT", "", "", "150", "", "NULLABLE", "NON_REQUIRED", "")

arcpy.AddField_management(MAPU_STAT_TBL, "MAP_UNIT_SYMBOL_100", "TEXT", "", "", "150", "", "NULLABLE", "NON_REQUIRED", "")

arcpy.AddField_management(MAPU_STAT_TBL, "MAP_UNIT_SYMBOL_24", "TEXT", "", "", "150", "", "NULLABLE", "NON_REQUIRED", "")

arcpy.AddField_management(MAPU_STAT_TBL, "MAP_UNIT_SYMBOL_OTHER", "TEXT", "", "", "150", "", "NULLABLE", "NON_REQUIRED", "")