Lecture 6 Digital Data Sources

March 6, 2017

Digital spatial data

Many spatial data currently exist in digital formats

Data are increasingly collected in digital formats.

Web delivered, from government and to a lesser extent private sources.

National and global digital data

NASA – global data: elevation, land use, ecosystem type etc
Max Planck Institute – Precipitation
GSDI (Global Spatial Dataset Infrastructure)

Digital Sources (NGDC, USGS National Map)
Focus on eight nationwide datasets:

- NLCD – National Land Cover Datasets

- USGS Digital Raster Graphics (DRG)

- USGS Digital Line Graphs (DLG)

- USGS Digital Orthophoto Quadrangles (DOQ)

- USFWS National Wetlands Inventory (NWI)

- Digital Soil Data (National & State)

- USGS Digital Elevation Models (DEMs)

- USDOC Census/TIGER Files

NLCD – National Land Cover Data

10-year repeat cycle, 1992, 2001, 2010

based on satellite images, 30 meter cell size

Water
11 open water
12 perennial ice/snow

Developed
21 low intensity residential
22 high intensity residential
23 commercial/industrial/
    transportation

Barren
31 bare rock/sand/clay
32 quarries/strip mines/
    gravel pits
33 transitional

Forested Upland
41 deciduous forest
42 evergreen forests
43 mixed forests

Shrubland
51 shrubland

Non-natural Woody
61 orchard/vineyard/other
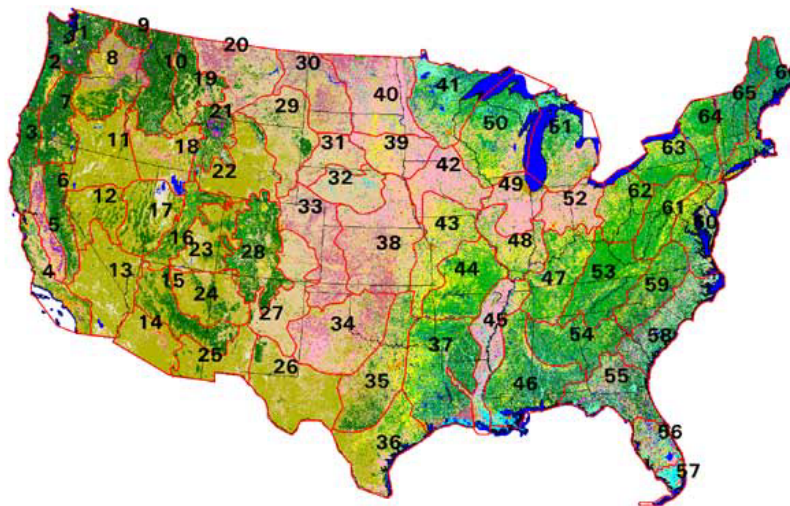
Herbaceous Upland Natural
71 grassland/herbaceous

Herbaceous Planted/
Cultivated
81 pasture/hay
82 row crop
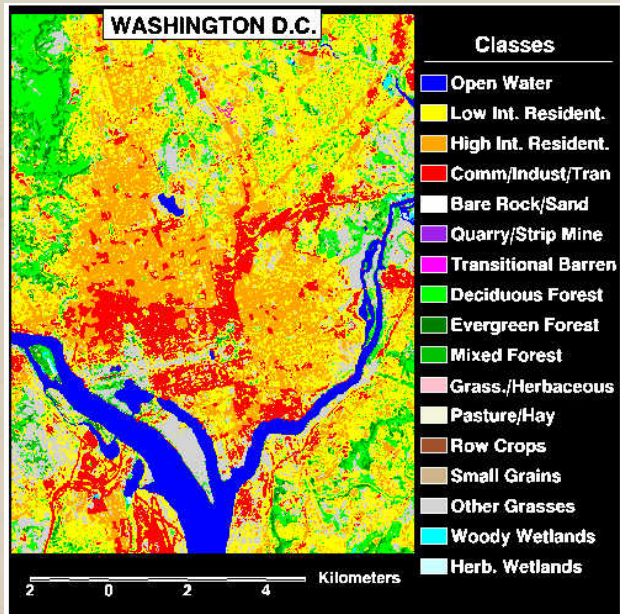83 small grains
84 fallow
85 urban/recreational grasses

Wetlands
91 woody wetlands
92 emergent herbaceous
    wetlands

NLCD 2000 Mapping Zones

Example: NLCD

WASHINGTON D.C.

Classes
- Open Water
- Low Int. Resident.
- High Int. Resident.
- Comm/Indust/Tran
- Bare Rock/Sand
- Quarry/Strip Mine
- Transitional Barren
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Grass./Herbaceous
- Pasture/Hay
- Row Crops
- Small Grains
- Other Grasses
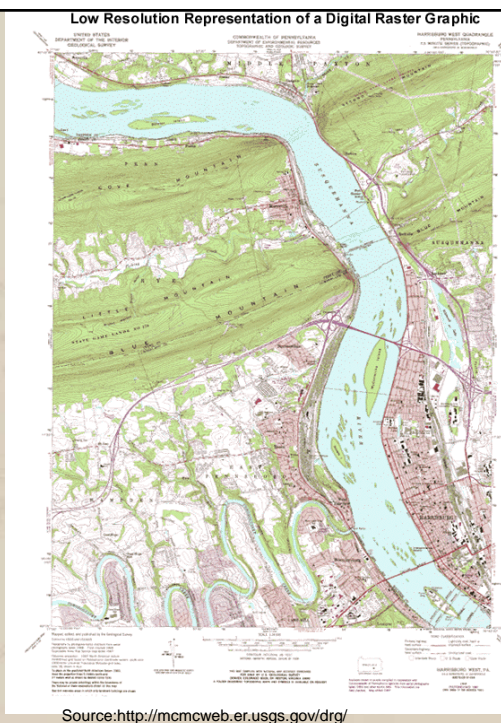- Woody Wetlands
- Herb. Wetlands

Kilometers 2 0 2 4

Digital Raster Graphic (DRG)

A scanned image of a U.S. Geological Survey (USGS) map

Georeferenced to the Universal Transverse Mercator projection

Scanned at a minimum resolution of 250 dots per inch.

Low Resolution Representation of a Digital Raster Graphic

Source:http://mcmcweb.er.usgs.gov/drg/

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Slide 1

Digital Raster Graphic (DRG)

If scanned at 250 dpi from a 1:24,000 scale source, what is the approximate ground resolution?
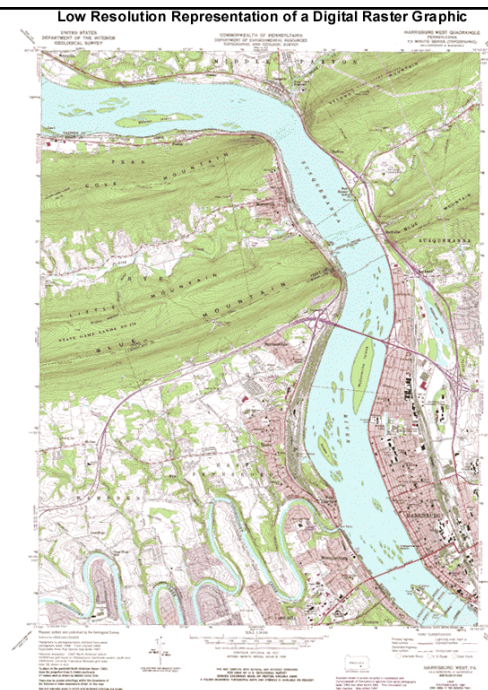
Low Resolution Representation of a Digital Raster Graphic

Slide 2
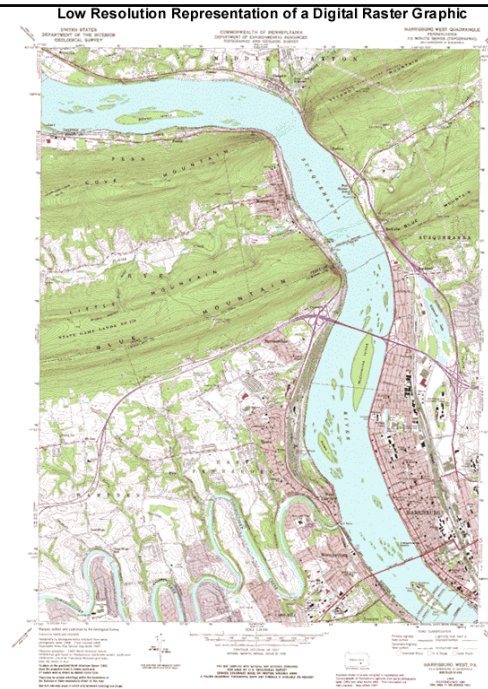
Digital Raster Graphic (DRG)

If scanned at 250 dpi from a 1:24,000 scale source, what is the approximate ground resolution?

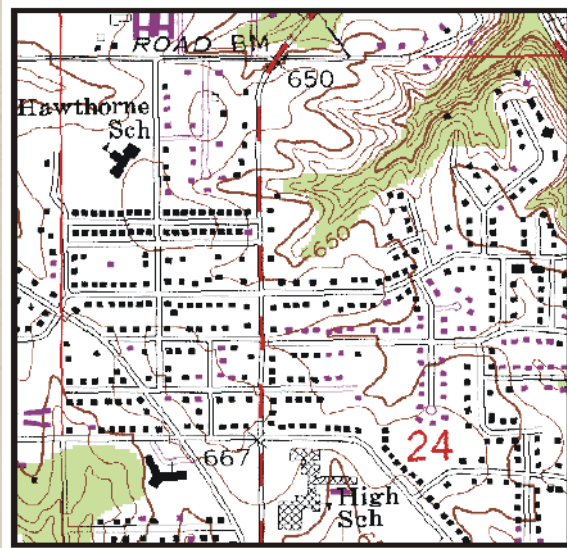1/250 in* 24,000 in/in * 1ft/12 in

= 8 feet

Low Resolution Representation of a Digital Raster Graphic

USGS Digital Raster Graphics (DRG) A georeferenced
raster image of a scanned USGS map

Digital Line Graphs (DLG)

Point and line locations from 1:24,000 and 1:100,000
maps, e.g., county and state boundaries, road
locations, structure locations, etc.

Digitized by USGS using standard methods, little
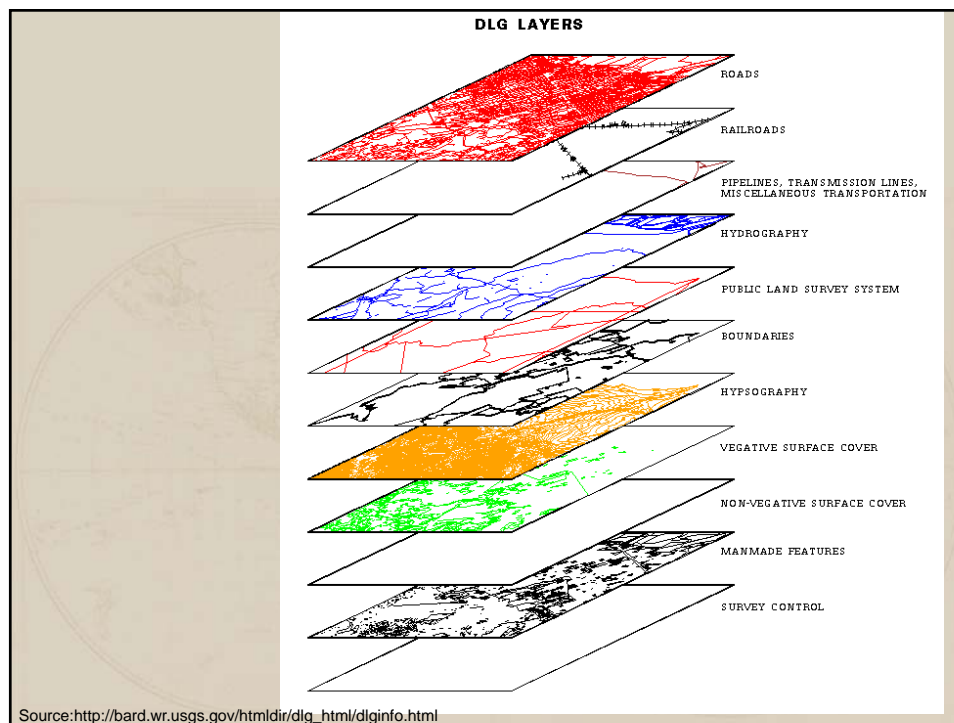accuracy lost in conversion, available at well below
their production cost

Available by map series, ie. 1:24,000, 1:100,000, 1:2
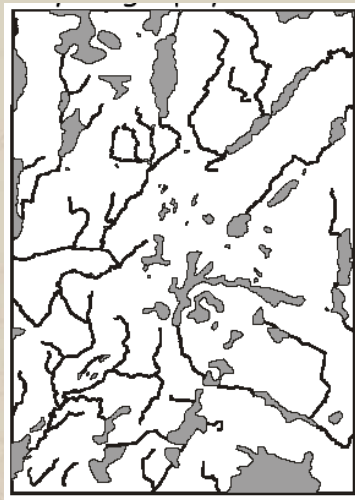million

Digital Line Graphs (DLG)

Separate themes provided *(4 for 1:100,000, 11 for 1:24,000)*

- •Boundaries (political & administrative
- •Hydrography (lakes, rivers, glaciers)
- •Roads
- •Hypsography (elevation contours)
- •Transportation
- •Vegetation & non Vegetation features (sand, gravel)
- •Monuments & Control points
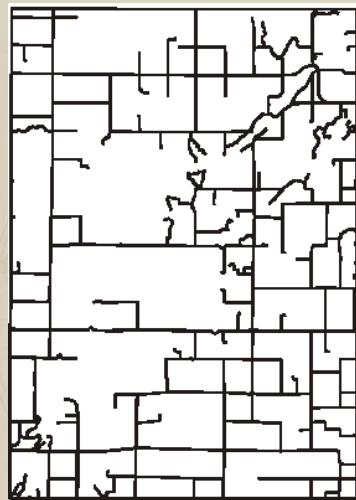- •Public Land Survey System
- •Man-made features

Delivered as text or binary files, use conversion utilities
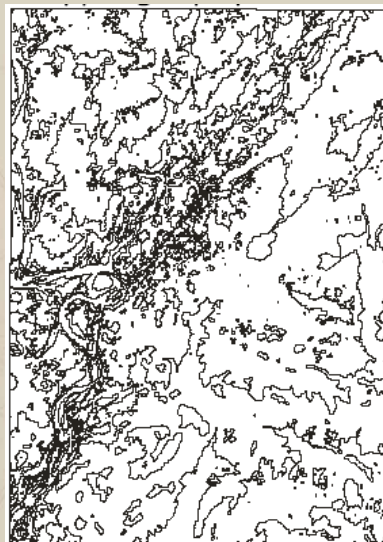to convert to vendor-specific data files

DLG LAYERS

ROADS

RAILROADS

PIPELINES, TRANSMISSION LINES,
MISCELLANEOUS TRANSPORTATION

HYDROGRAPHY

PUBLIC LAND SURVEY SYSTEM

BOUNDARIES

HYPSOGRAPHY

VEGATIVE SURFACE COVER

NON-VEGATIVE SURFACE COVER

MANMADE FEATURES

SURVEY CONTROL

Source:http://bard.wr.usgs.gov/htmldir/dlg_html/dlginfo.html

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DLG Hydrography   DLG Roads

DLG
Hypsography
(elevation)

Digital Line Graphs (DLG)

Data is often edge matched along map seams
*(though sometimes one map series has been updated and not the adjoining
maps so manual edge matching is required)*

Delivered as text or binary files *(use conversion utilities to
convert to vendor-specific data files)*

Most often in UTM coordinate system

Several formats are provide such as DLG-3 or SDTS
(Spatial Data Transfer Standard)

DLG's provide limited attribute data but conveys
important topological and categorical relationships (road
type; major/minor road, unpaved)

Data is often
edge matched
along map
seams
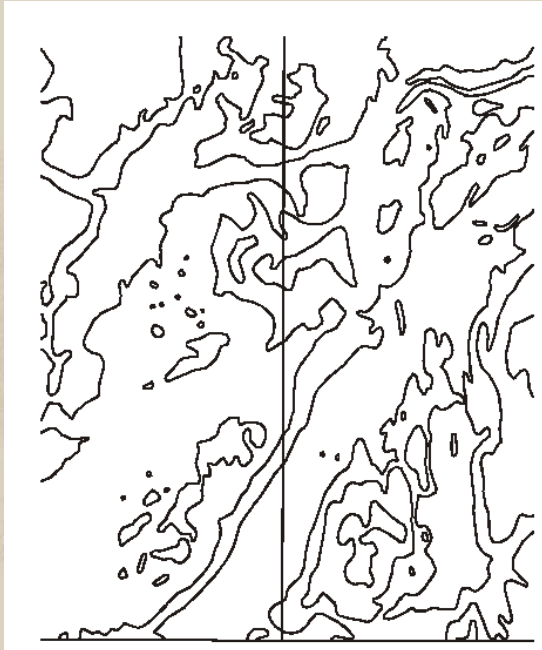
USGS Digital Orthophoto Quadrangles (DOQ)
•Orthophotos - corrected for distortions due to camera tilt, terrain displacement, and other factors.
•Nationwide availability (nearly)

USGS Digital Orthophoto Quadrangles (DOQ)

As most features larger than 1 meter are visible these images are the basis of many types of analysis and other data layers, for example:

*Establishing ground control points.*
Creating or updating roads data layers
Vegetation data layers
Time series analysis (temporal changes such as urban expansion)

National Wetlands Inventory (NWI)

- Data on the location and condition of wetlands throughout much of the United States

- National Inventory, created by the US Fish and Wildlife Service

National Wetlands Inventory (NWI)

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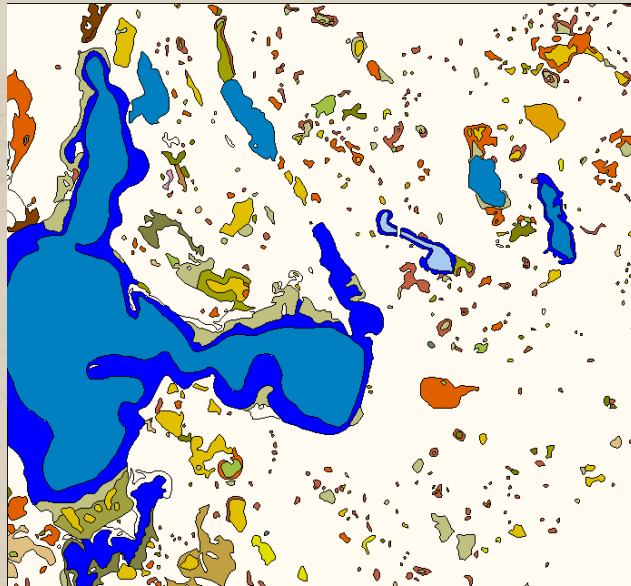
National Wetlands Inventory (NWI)

Maps depict wetlands as interpreted from photos taken on a single (usually Spring or Summer) date.

Photo-interpreted, surface water and wetland vegetation are keys to identification.

Ephemeral wetlands (e.g., floodplain forests, vernal pools) and those with sub-surface water tables often missed, particularly if vegetation structure similar (e.g., "fresh" meadows).

National Wetlands Inventory (NWI)

Typical minimum mapping unit (MMU) are between .5 and 2 hectares (vary by vegetation, source, region, etc.)

NWI depict wetland by type with a hierarchical classification scheme with modifiers

National Wetlands Inventory (NWI)

Wetlands codes are typically a string of characters, each corresponding to an attribute in a hierarchy. For example, a wetland might be labeled L1UBG, indicating it is:

L   for lacustrine (system)
1   for limnetic (subsystem)
UB   for unconsolidated Bottom (Class)
G   intermittently exposed (a modifier) G
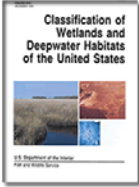
National Wetlands Inventory (NWI)

National Wetlands Inventory (NWI)

Cowardian Classification

http://wetlands.fws.gov/Pubs_Reports/Class_Manual/class_titlepg.htm

National Wetlands Inventory (NWI)

• <u>Systems</u> are Marine, Estuarine, Riverine, Lacustrine, and Palustrine

• <u>Subsystems</u> subtidal, intertidal, tidal, perennial, intermittent, limnetic (away from shore) and littoral (near shore)

• <u>Class</u> defines general bottom or vegetation conditions (e.g., rock bottom, scrub-shrub wetland).
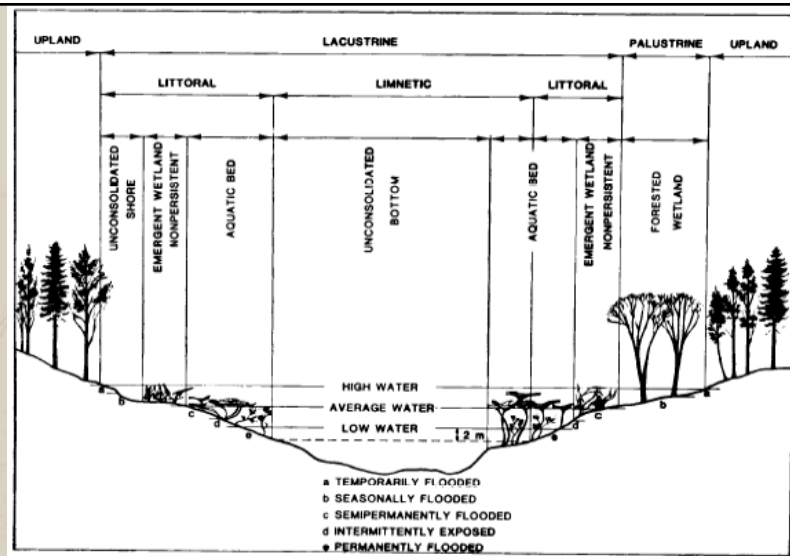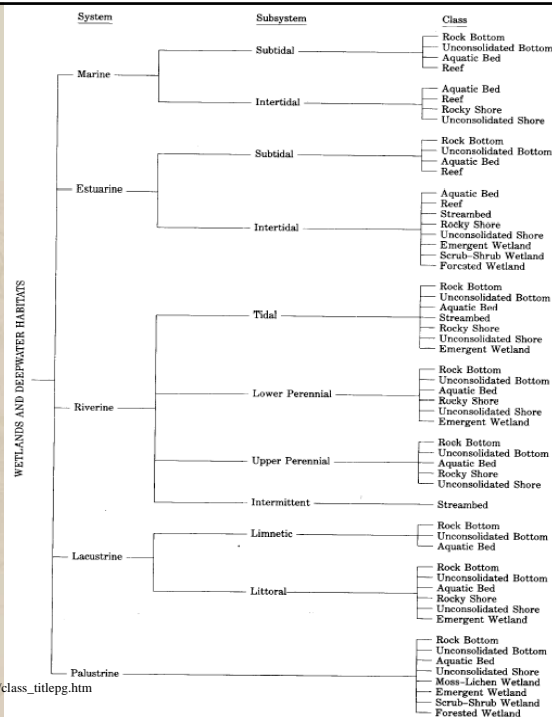
There are at least two shortened designators which may appear on wetlands maps,

U = Uplands, and
OUT = out of the mapped area.

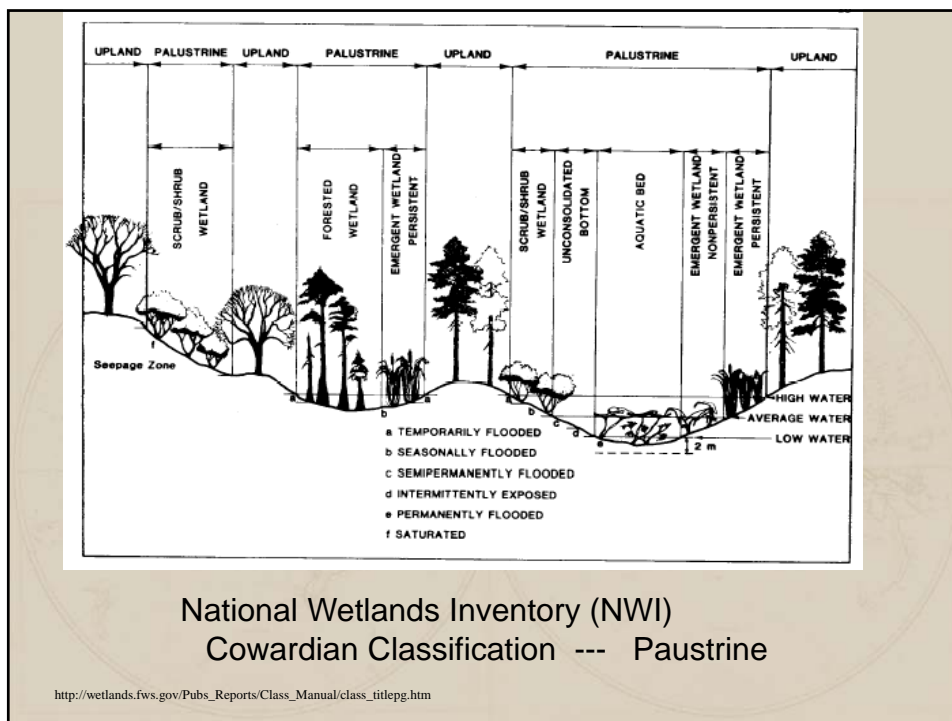**National Wetlands Inventory (NWI)**

Cowardian Classification

http://wetlands.fws.gov/Pubs_Reports/Class_Manual/class_titlepg.htm

National Wetlands Inventory (NWI)
Cowardian Classification ---   Lacustrine

http://wetlands.fws.gov/Pubs_Reports/Class_Manual/class_titlepg.htm

National Wetlands Inventory (NWI)
Cowardian Classification --- Paustrine

http://wetlands.fws.gov/Pubs_Reports/Class_Manual/class_titlepg.htm

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National Wetlands Inventory (NWI)

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Digital Soils Data

National
Natural Resource Conservation Service (NRCS)
(Digital soil data sets at different scales and extents)

National Soil Geography (NATSGO), national coverage, small scale.

State Level
State Soil Geographic (STATSGO) data intermediate scale and resolution. *(1:250,000)*

Soil Survey Geographic (SSURGO) data at a very large scale provides the most spatial and categorical detail. *(used by land owners, farmers, planners – county level)*

The map on the left is from the 1926 Wadena County soil survey at a scale of 1 inch = 1 mile. The map on the right is from the 1991 soil survey of the County at a scale of 3.19 inches = 1 mile. Modern surveys are made with aerial photography as the background at a larger scale.

Source:http://www.mn.nrcs.usda.gov/soils/ken/cent/wadena.jpg

Source: http://tahoe.usgs.gov/soil.html

Source: http://tahoe.usgs.gov/soil.html

Digital Soils Data

SSURGO data are developed from soil surveys (field and photo measurements)

Soil Surveys are digitized and have positional accuracy similar to the 1:24,000 quad maps. (< 13m for 90% of points)

Extensive detail (other data files) about individual soil series can be linked via a unique identifier. (soil chemistry, physical properties, suitability for building, depth to bedrock, etc.)
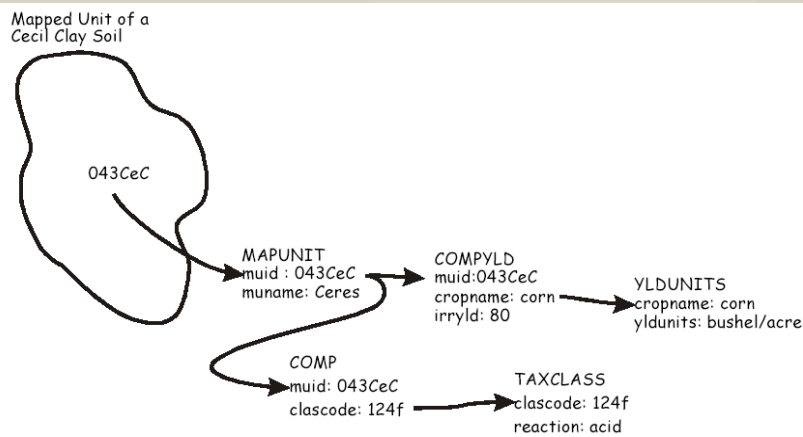
Digital Soils Data – Accessing Attributes

Mapped Unit of a Cecil Clay Soil

043CeC

MAPUNIT
muid : 043CeC
muname: Ceres

COMPYLD
muid:043CeC
cropname: corn
irryld: 80

YLDUNITS
cropname: corn
yldunits: bushel/acre

COMP
muid: 043CeC
clascode: 124f

TAXCLASS
clascode: 124f
reaction: acid

Figure 7-10: The database schema associated with the SSURGO digital soils data. Variables describing soil characteristics are provided in a set of relatable tables. Keys in each table, shown in bold, provide access to items of interest. Codes provided with the digital geographic data, e.g., the map unit identifier (muid), provide a link to these data tables. The relation of a mapped soil polygon to attribute data is shown in the example shown at the bottom of the figure. The muid is related from the MAPUNIT and COMP table, which in turn are used to access other variables through additional keys.

Digital Elevation Models

- Raster data sets of elevation

- Usually developed using photogrammetric surveys

- Useful for slope, aspect, visibility calculations
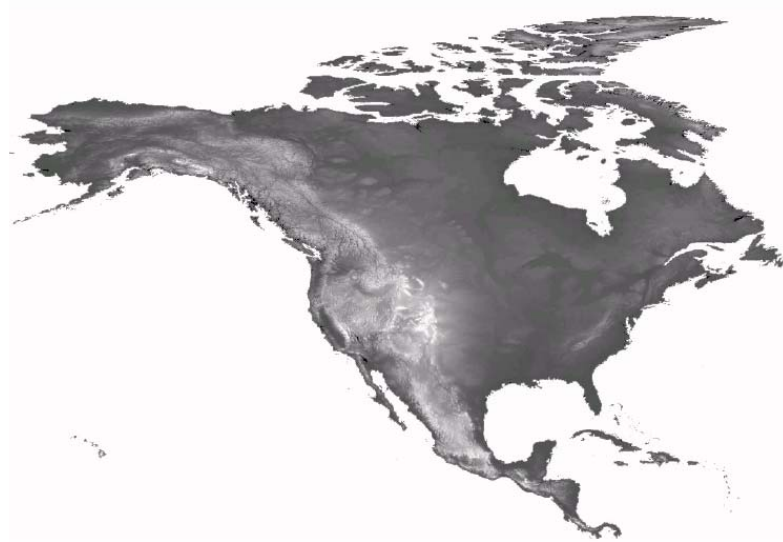
Figure 7-4: Digital elevation models (DEMs) are available at various resolutions and coverage areas for most of the world. This figure of North America was produced using data that have been derived from 1:2,000,000 maps and are available from the USGS.

On maps, elevation often depicted as contour lines

——	contour
——	stream
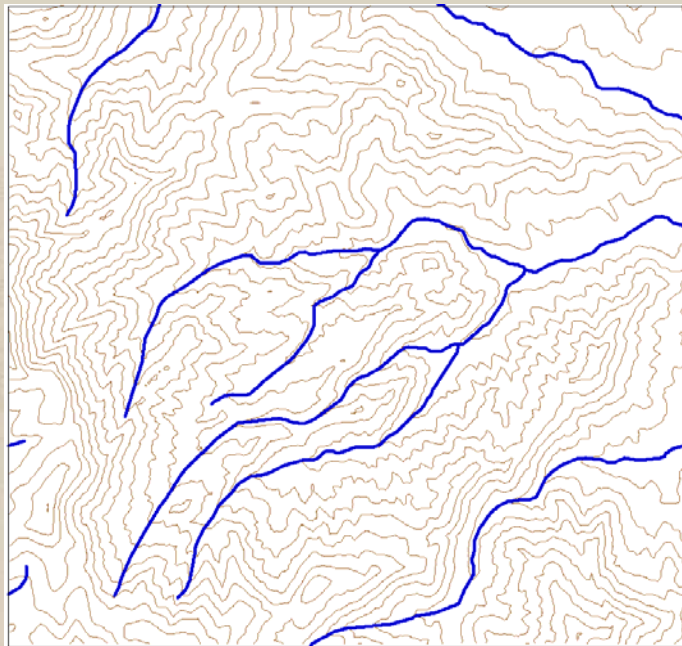
Digital Elevation Models (DEMs)
May be defined as digital representations of
earth's surface

Typically point fields in layer *(may be raster or vector,
note this can't represent overhangs)*

•Represent elevation using a raster data
model
•As with the DLGs they are available from
 several origins and accuracies.
•The most useful for most natural resource
 applications are based on the 1:24,000
USGS topographic map series

DEMs produced using any one of several
methods:

-Gestalt photomapper, parallax on photopairs

-Interpolated from digitized contours

-Interpolated from points (low relief)

Data delivered with a 30-meter grid cell size.

DEM

Raster Grid

Cells contain elevation values

Streams show valley locations

Figure 7-5: DEMs provided by the USGS are arranged as a series of postings in lines parallel to the local Northing direction. Data are provided at a fixed sampling frequency that is usually constant along and between posting lines.

Population Change by Census Tract, 1990 - 1999

Persons Increase
7,182 - 13,685
4,174 - 7,181
2,380 - 4,173
500 - 2,379
0 - 500
-590 - 0

TIGER/Census data come in two parts:

•Line files, depicting county, state, census tract, or other areas or boundaries

•Data files, containing attributes on population, age, income, race, housing, or other important variables for the areas

TIGER Line files contain data on:

Line features,
e.g., roads, railroads, hydrography

Landmark features,
e.g., schools (point), churches (point), parks (Polygon)

Polygon features,
e.g., counties, census tracts

Points, lines, and polygons in TIGER/line files are identified and indexed via a complex but well-defined set of codes.

Records contain information about features, plus indices to other records

Various types of records are used to specify feature properties

TIGER/Census data are used to define polygons, and summary attributes for those polygons. Census data may be summarized at several nested levels:

- State
- Counties
- Tracts
- Block groups

- Or, Census data may also be summarized by Congressional districts
- FIPS zones (Federal Information Processing Standard zones)

Only a partial list today. There are also:

- Floodplain data (FEMA)
- Federal managed lands (e.g., USFS, BLM)
- State road networks through DOT
- EPA watershed boundary and river reach data
- National Aerial Imagery Program (NAIP)
- Data sources for Mississippi: MARIS, NOAA CSC
- Marine GIS https://library.stanford.edu/hopkins/research-help/gis-resources-marine-sciences