COA 690/790 GIS in Marine Science

Lecture 6 Digital Data Sources

March 6, 2017

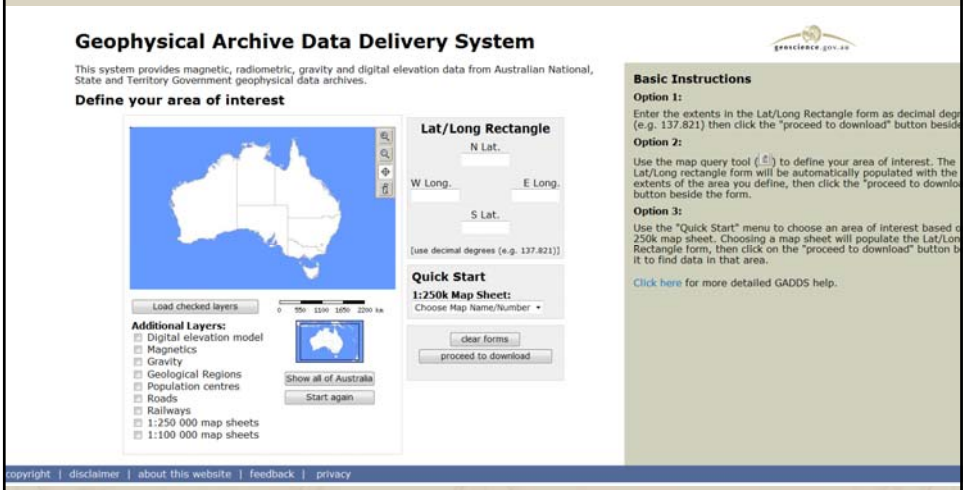
Digital spatial data

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

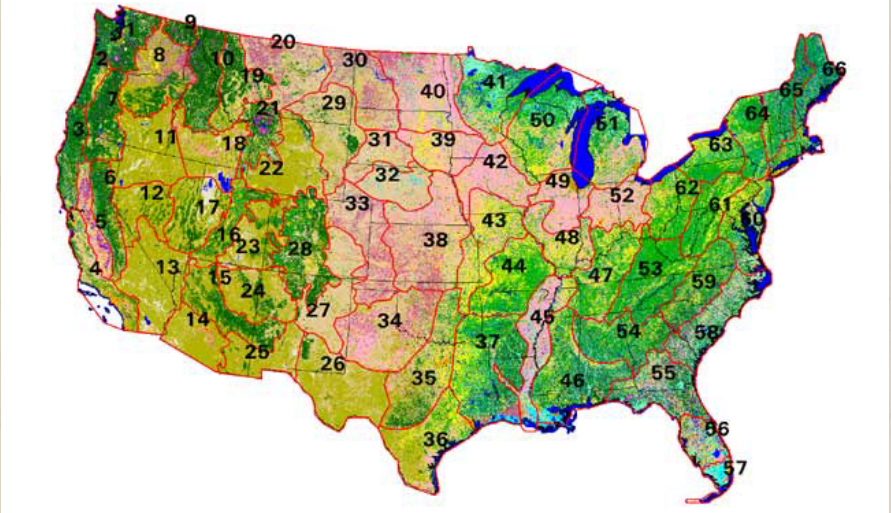
Non-natural Woody
61 orchard/vineyard/other

Herbaceous Upland Natural
71 grassland/herbaceous

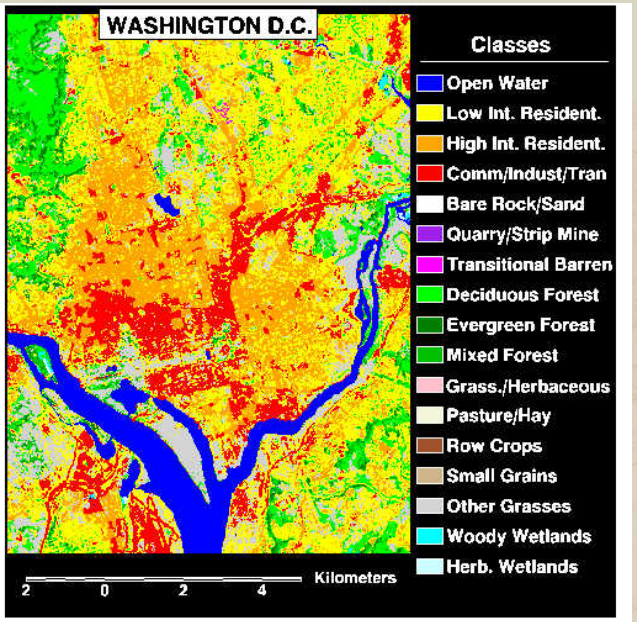
Herbaceous Planted/ Cultivated
81 pasture/hay
82 row crop
83 small grains
84 fallow
85 urban/recreational grasses

Wetlands
91 woody wetlands
92 emergent herbaceous wetlands

NLCD 2000 Mapping Zones



Example: NLCD



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/

Digital Raster Graphic (DRG)

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

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

Low Resolution Representation of a Digital Raster Graphic

Digital Raster Graphic (DRG)

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

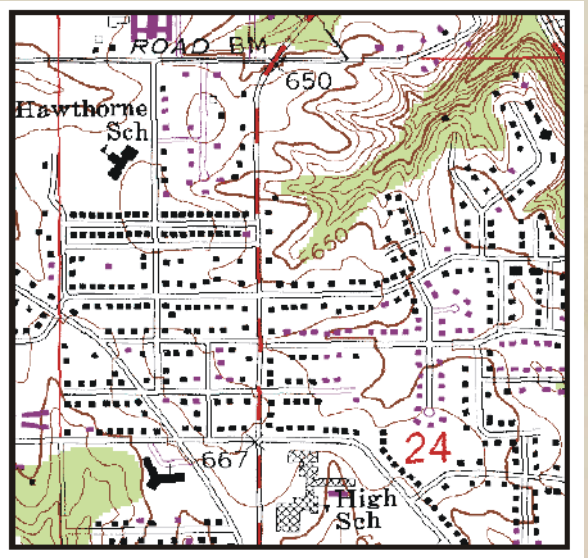
1/250 in* 24,000 in/in * 1ft/12 in

= 8 feet

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

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

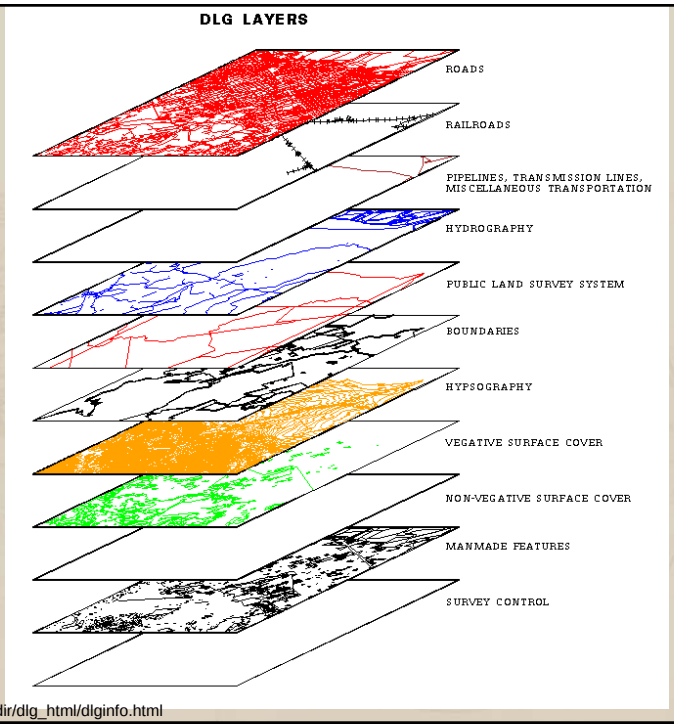
Available by map series, ie. 1:24,000, 1:100,000, 1:2 million

Digital Line Graphs (DLG)

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

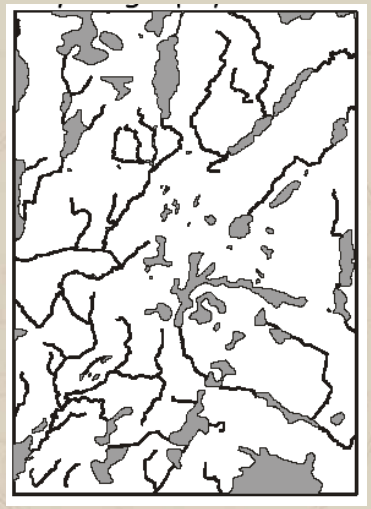
- •Boundaries (political & administrative
- •Hydrography (lakes, rivers, glaciers)
- •Roads
- •Hypsography (elevation contours)
- •Transportation
- •Vegetation & non Vegetation features (sand, gravel)
- •Monuments & Control points
- •Public Land Survey System
- •Man-made features

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

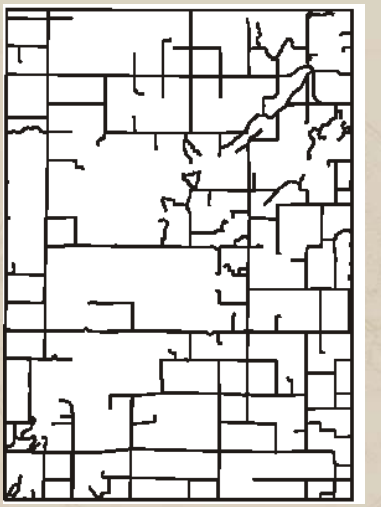


Source:http://bard.wr.usgs.gov/htmldir/dlg_html/dlginfo.html

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)

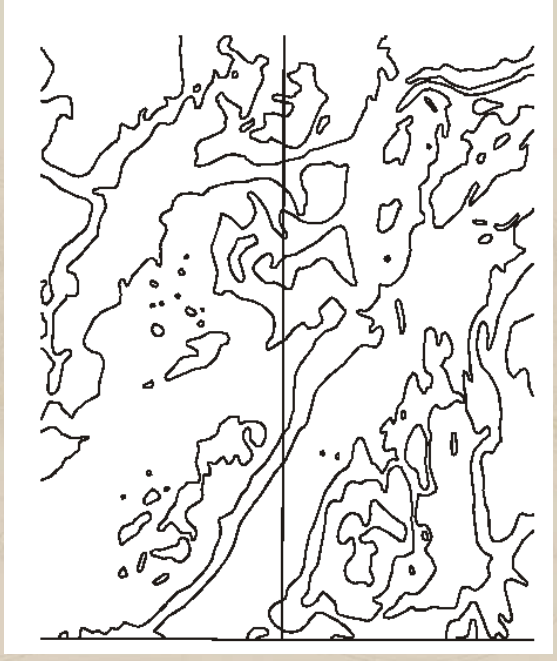
Delivered as text or binary files *(use conversion utilities to convert to vendor-specific data files)*

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)

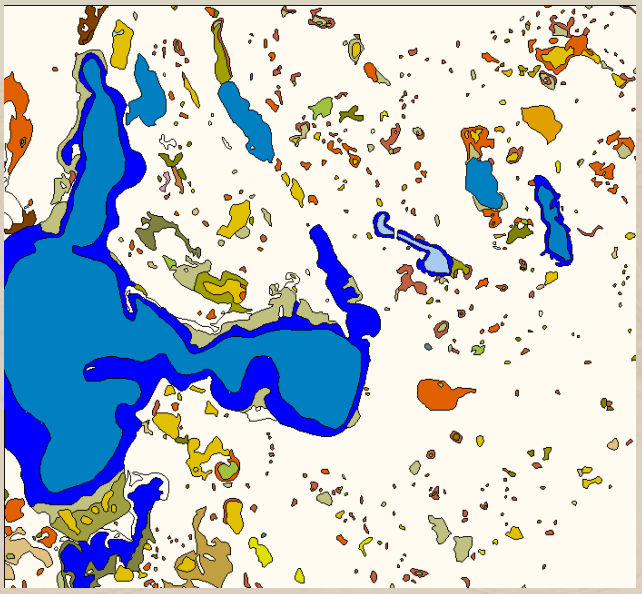
As most features larger than 1 meter are visible these images are the basis of many types of analysis and other data layers, for example:

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)



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.)

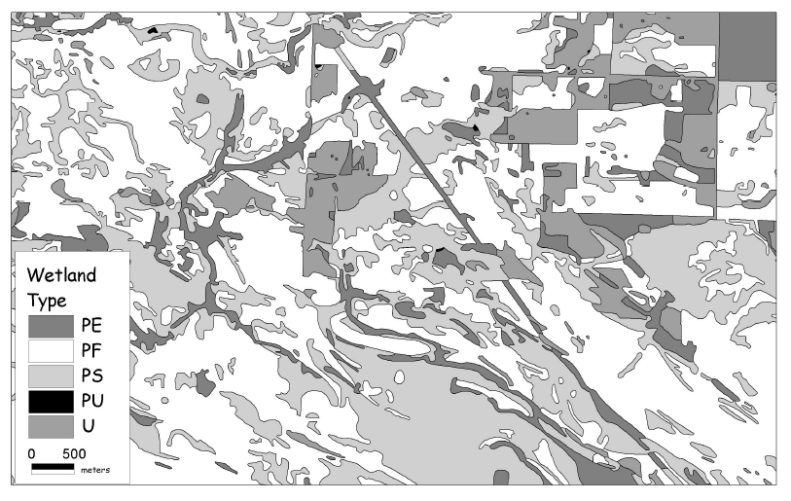
NWI depict wetland by type with a hierarchical classification scheme with modifiers

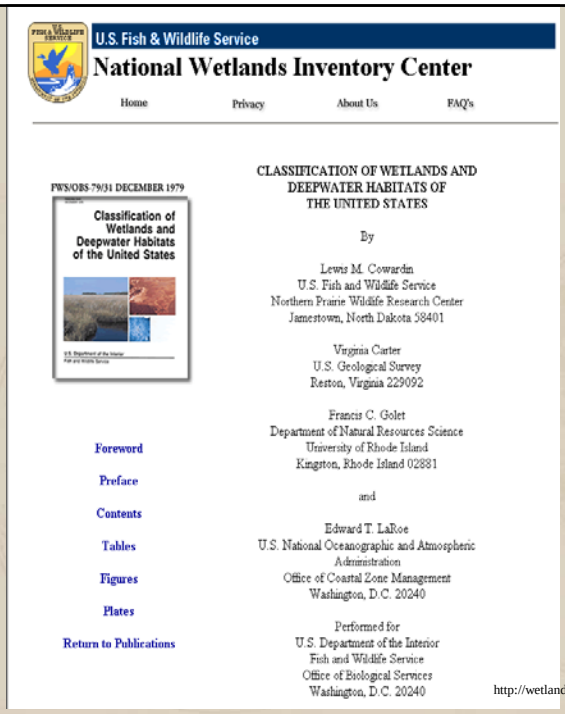
National Wetlands Inventory (NWI)

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)





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

National Wetlands Inventory (NWI)

Cowardian Classification

National Wetlands Inventory (NWI)

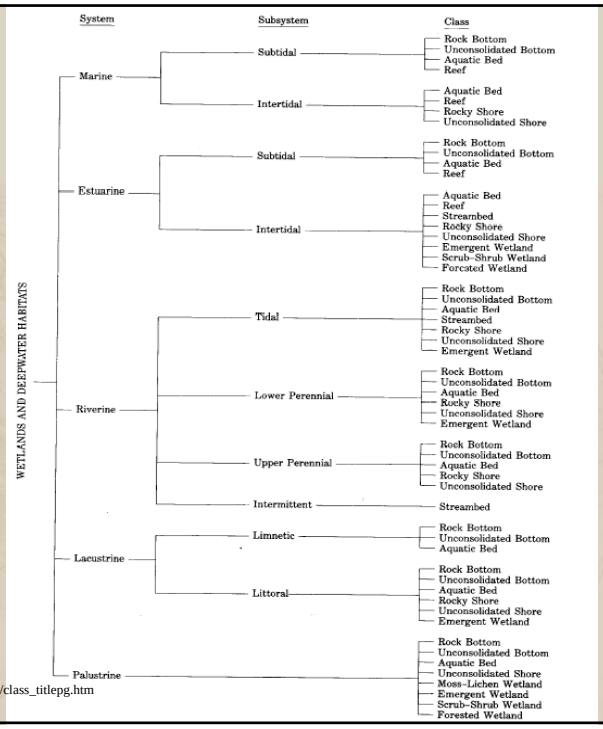
- Systems are Marine, Estuarine, Riverine, Lacustrine, and Palustrine
- Subsystems subtidal, intertidal, tidal, perennial, intermittent, limnetic (away from shore) and littoral (near shore)
- Class defines general bottom or vegetation conditions (e.g., rock bottom, scrub-shrub wetland).

There are at least two shortened designators which may appear on wetlands maps,

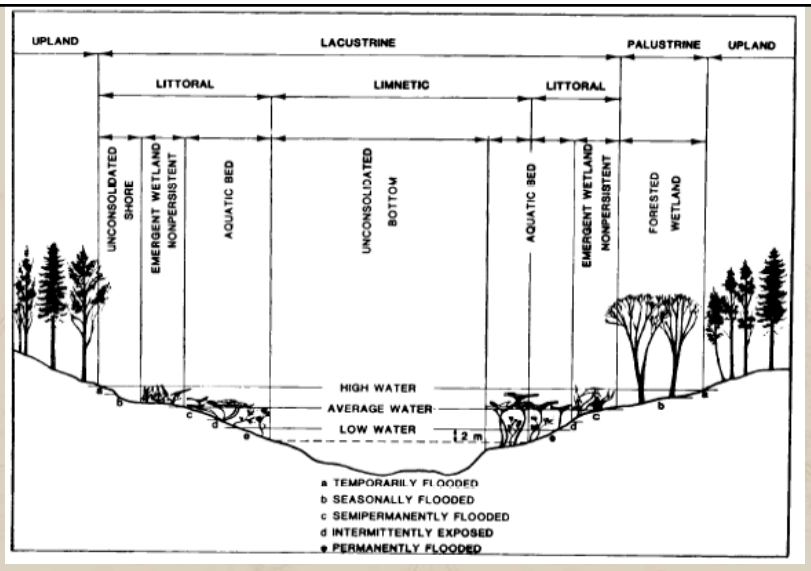
U = Uplands, and
OUT = out of the mapped area.

National Wetlands Inventory (NWI)

Cowardian Classification

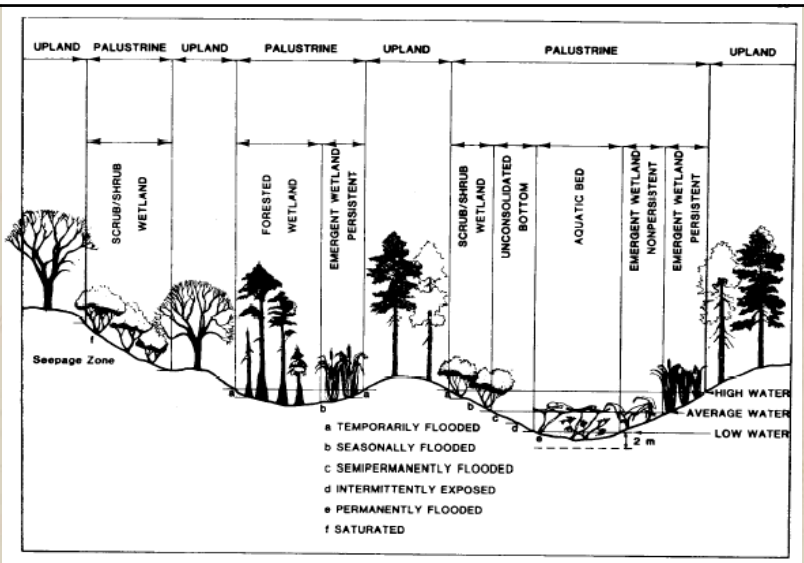


http://wetlands.fws.gov/Pubs_Reports/Class_Manual/class_titlepg.htm



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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Digital Soils Data

National

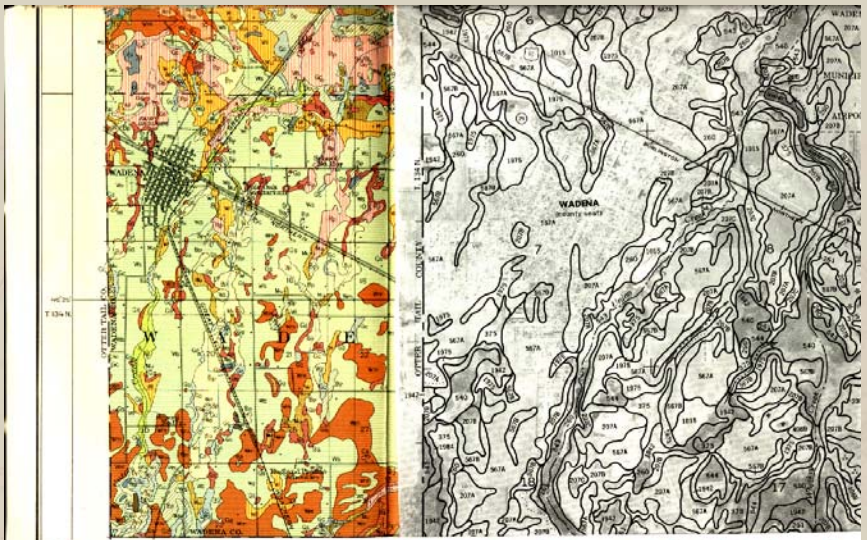
Natural Resource Conservation Service (NRCS)
(Digital soil data sets at different scales and extents)

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

State Level

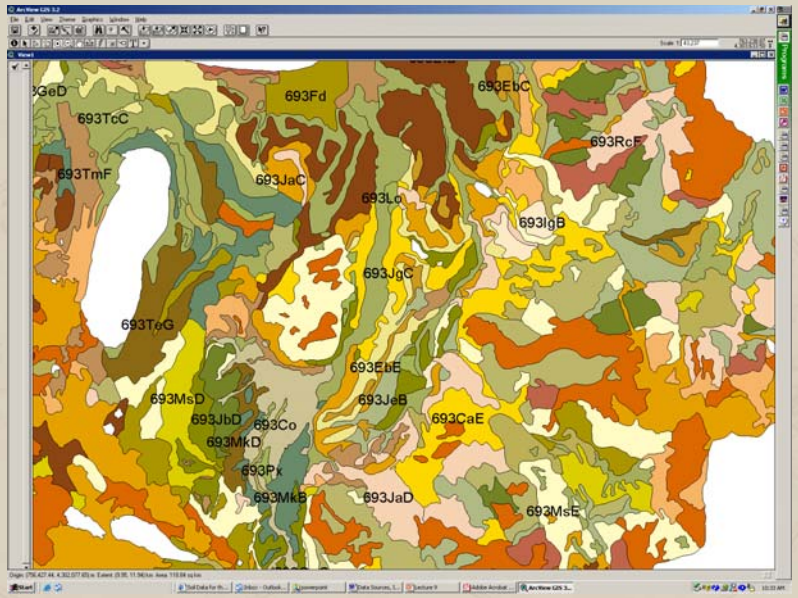
State Soil Geographic (STATSGO) data intermediate scale and resolution. *(1:250,000)*

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)*

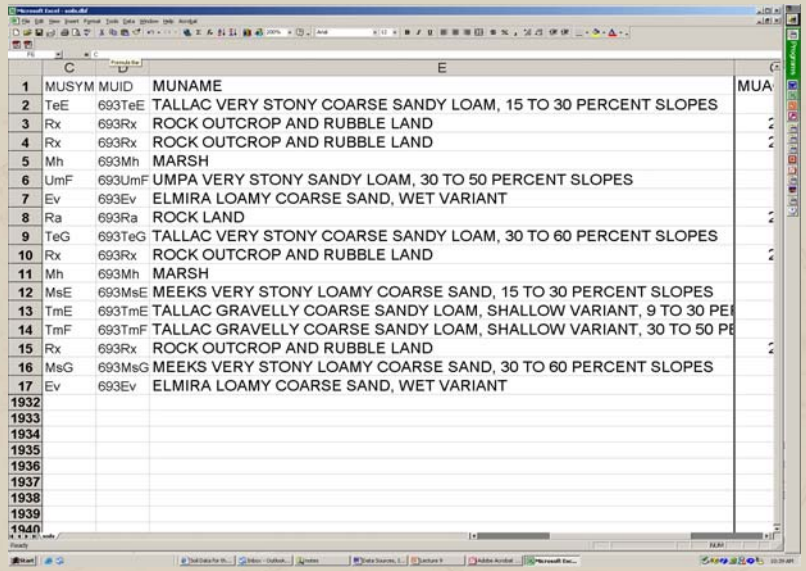


The map on the left is from the 1926 Wadena County soil survey at a scale of 1 inch = 1 mile. The map on the right is from the 1991 soil survey of the County at a scale of 3.19 inches =1 mile. Modern surveys are made with aerial photography as the background at a larger scale.

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



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



	C	D	E
1	MUSYM	MUID	MUNAME
2	TeE	693TeE	TALLAC VERY STONY COARSE SANDY LOAM, 15 TO 30 PERCENT SLOPES
3	Rx	693Rx	ROCK OUTCROP AND RUBBLE LAND
4	Rx	693Rx	ROCK OUTCROP AND RUBBLE LAND
5	Mh	693Mh	MARSH
6	UmF	693UmF	UMPA VERY STONY SANDY LOAM, 30 TO 50 PERCENT SLOPES
7	Ev	693Ev	ELMIRA LOAMY COARSE SAND, WET VARIANT
8	Ra	693Ra	ROCK LAND
9	TeG	693TeG	TALLAC VERY STONY COARSE SANDY LOAM, 30 TO 60 PERCENT SLOPES
10	Rx	693Rx	ROCK OUTCROP AND RUBBLE LAND
11	Mh	693Mh	MARSH
12	MsE	693MsE	MEEKS VERY STONY LOAMY COARSE SAND, 15 TO 30 PERCENT SLOPES
13	TmE	693TmE	TALLAC GRAVELLY COARSE SANDY LOAM, SHALLOW VARIANT, 9 TO 30 PE
14	TmF	693TmF	TALLAC GRAVELLY COARSE SANDY LOAM, SHALLOW VARIANT, 30 TO 50 PE
15	Rx	693Rx	ROCK OUTCROP AND RUBBLE LAND
16	MsG	693MsG	MEEKS VERY STONY LOAMY COARSE SAND, 30 TO 60 PERCENT SLOPES
17	Ev	693Ev	ELMIRA LOAMY COARSE SAND, WET VARIANT

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

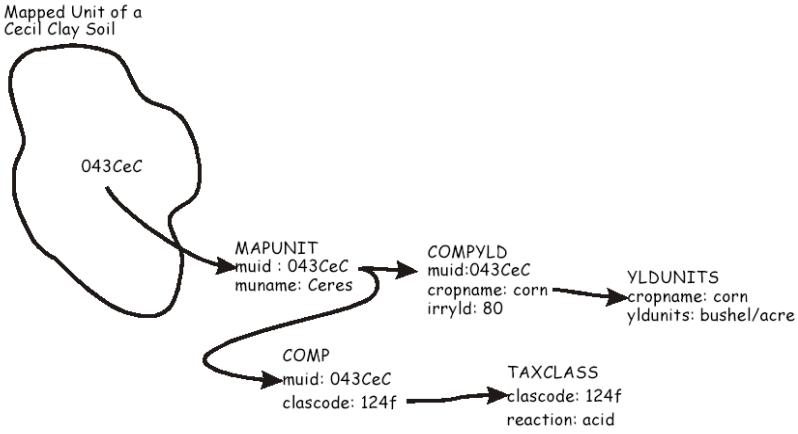


Figure 7-10: The database schema associated with the SSURGO digital soils data. Variables describing soil characteristics are provided in a set of relatable tables. Keys in each table, shown in bold, provide access to items of interest. Codes provided with the digital geographic data, e.g., the map unit 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

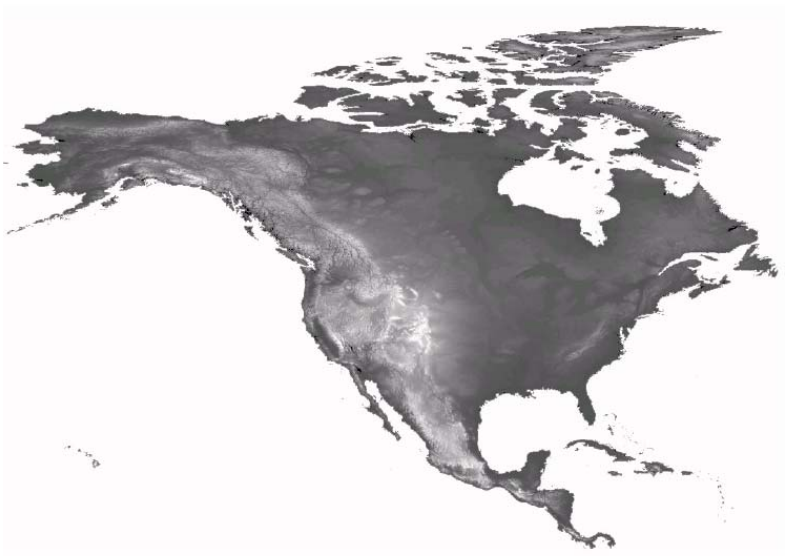
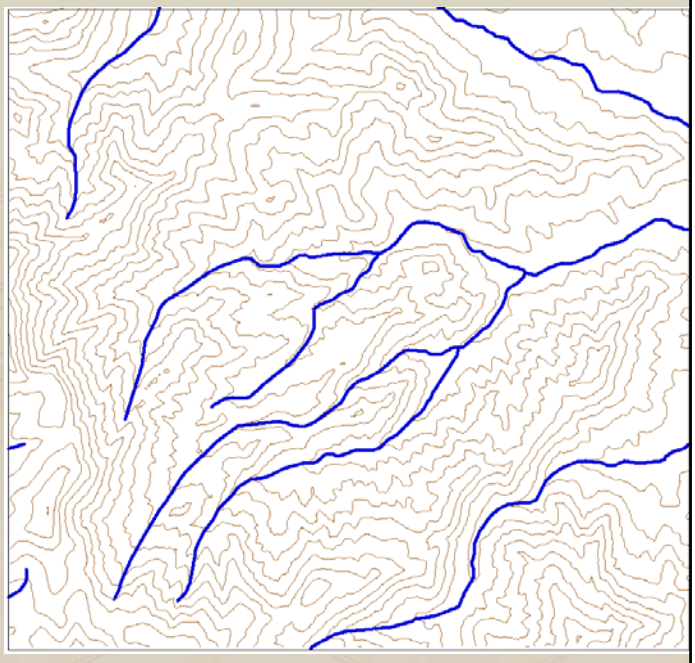


Figure 7-4: Digital elevation models (DEMs) are available at various resolutions and coverage areas for most of the world. This figure of North America was produced using data that have been derived from 1:2,000,000 maps and are available from the USGS.

On maps, elevation often depicted as contour lines



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

1065	1068	929	864	960	1113	974	896	890	841	759	719	705	696	720	708
1038	963	947	950	999	1021	1011	1015	995	1044	870	773	734	703	676	684
1142	1005	1151	1044	1117	1056	1007	1002	902	954	935	913	789	756	724	700
1116	1114	1270	1165	1097	1025	922	917	821	829	860	838	807	810	758	760
1275	1170	1295	1114	1009	942	953	847	835	729	738	797	723	718	694	670
1441	1263	1196	1055	913	869	829	771	736	765	766	688	694	676	684	698
1348	1200	1056	969	948	951	940	867	818	863	784	732	704	733	776	804
1377	1238	1122	1019	1089	950	956	896	950	800	760	698	779	867	896	744
1489	1320	1188	1152	1050	942	922	952	845	841	721	780	852	928	845	738
1432	1415	1196	1100	1001	974	924	911	914	756	809	861	898	830	746	710
1412	1474	1240	1100	1001	982	873	835	829	853	931	937	845	706	685	680
1493	1368	1201	1090	1064	970	902	902	958	952	1015	841	782	803	786	711
1437	1407	1188	1145	1070	1107	982	1047	1077	1052	954	884	944	940	828	771
1349	1369	1267	1247	1194	1196	1077	1214	1145	999	906	894	1024	1046	923	862
1319	1292	1378	1400	1367	1276	1162	1088	961	930	872	985	1010	1178	1148	1000

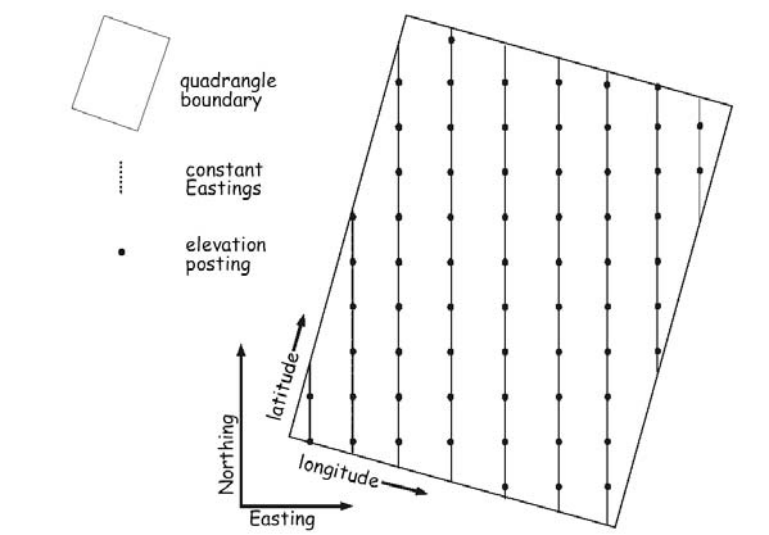
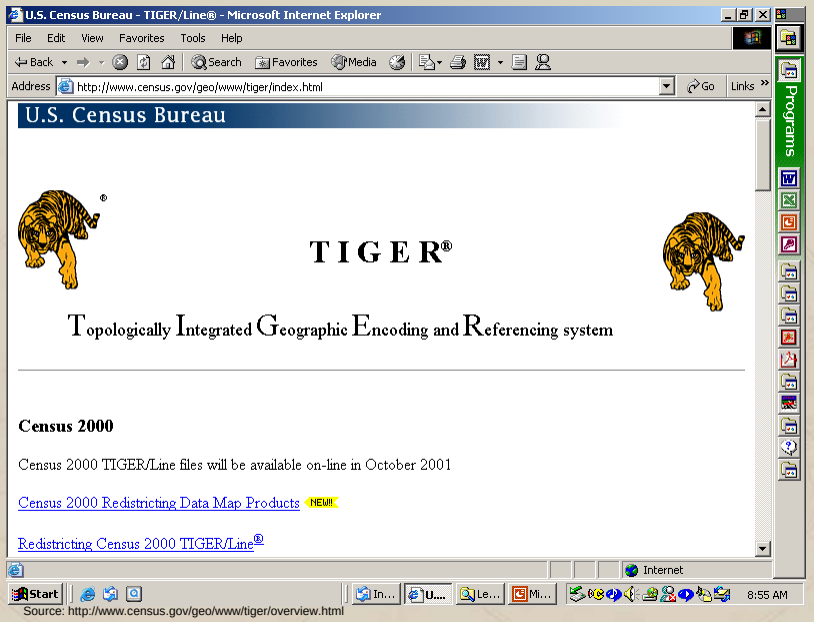
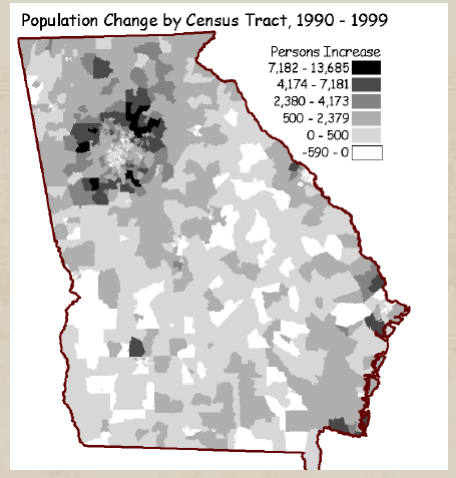


Figure 7-5: DEMs provided by the USGS are arranged as a series of postings in lines parallel to the local Northing direction. Data are provided at a fixed sampling frequency that is usually constant along and between posting lines.



Source: http://www.census.gov/geo/www/tiger/overview.html



Topology

An explicit definition of the spatial relationships among features.

Main components:
•Adjacency – e.g., polygons are adjacent
•Connectivity – e.g., arcs connect
•Containment – one polygon contains another, a set of arcs contain a polygon
•Direction – e.g., an arc has a direction, with a left and right side defined

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 define features with:

•ENTITY POINTS – points identifying the location of 0-dimensional features

•COMPLETE CHAINS – a sequence of non-intersecting line segments, with a start, end, left, and right defined

•NODES – Points that start, stop, or join chains

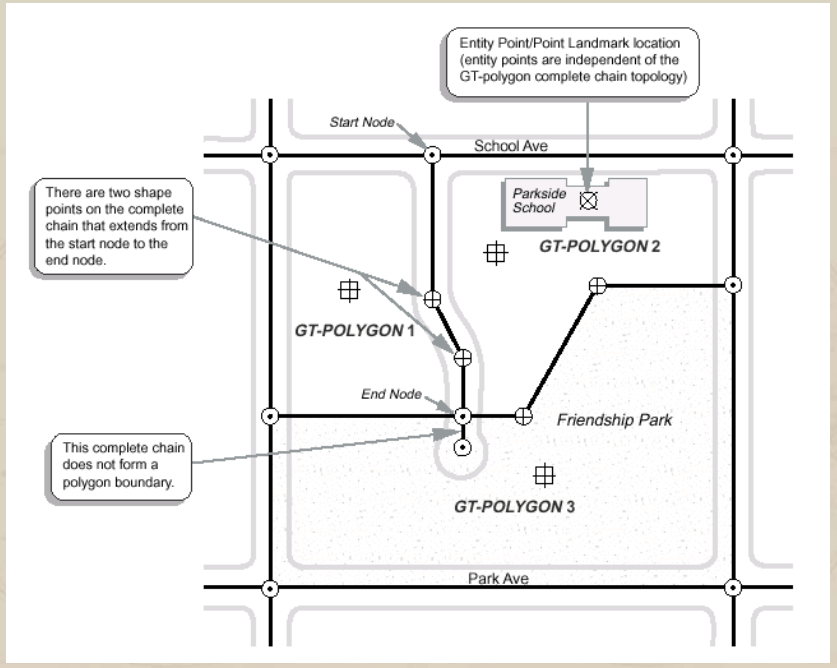
•GT-POLYGONS – Elementary polygons that are mutually exclusive and completely exhaust the surface

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



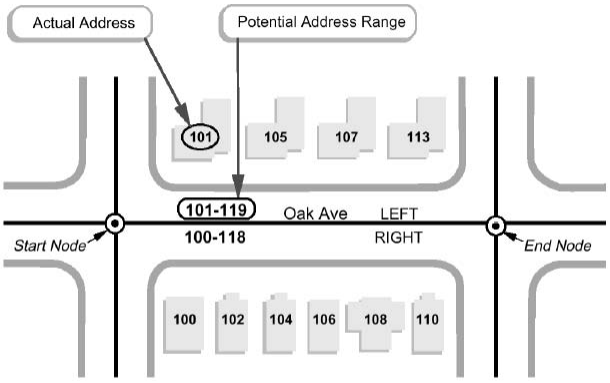


Figure 7-14: TIGER data provide address ranges for line (chain) segments. These ranges may be distributed across the line, giving approximate building locations on a street (from U.S. Dept. of Commerce).

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