Rock strata in central New York dip gently to the southwest. This cross-section exaggerates the dip and shows the sedimentary units and their ages. The oldest rocks in New York are the 1.1 billion year old metamorphic and igneous rocks of the Adirondacks. These ancient rocks contain no oil or gas, but host ore deposits for metals such as iron, titanium, lead and zinc, and minerals such as talc, wollastonite and garnet.

The red pattern indicates rock units that may serve as reservoir beds in central and western New York. These units contain gas only where the right combination of caprock and source beds is found.
Most gas wells in Madison County tap reservoirs in the Oswego Sandstone. The Utica Shale that underlies the sandstone is the source bed for the gas. Minor fold structures in the sandstone help to trap the gas in commercial quantities. Wells in the Town of Lebanon are developed in a minor fold structure where the sandstone is unusually thick. The overlying Ilion Shale forms a seal on the reservoir sandstone. Wells are typically 2500-4000’ deep.

Deeper wells (greater than 10,000 feet) in the eastern Finger Lakes region have encountered large reservoirs in the Trenton-Black River Group trend. Trenton-Black River discoveries are related to deep fault structures and have proven difficult to locate, but very profitable when exploited.
Gas exploration and development on private lands require that the landowner sell or lease mineral rights and access rights to their property. Landowners are strongly advised to consult a lawyer to review any contract before signing.

Modern seismic exploration involves laying out a grid of geophones (earth sound sensors) which receive sound reflections from subsurface rock layers. The sound source may be an explosive device, or more commonly ‘thumper’ trucks which use hydraulics and compressed air systems to ‘bump’ the ground.

The information from the geophone grid is then processed by high-speed computers to produce 2-D and 3-D cross-sections of subsurface structures. Advances in computer processing and software have made this sort of exploration more common over the last 15 years.

Production was reported for 23 gas wells in Madison County in 2005.

19 producing wells were located in the town of Lebanon; 4 in the town of Eaton.
Exploration and development of natural gas wells can have negative impacts on local infrastructure. Heavy drilling equipment may damage roads, culverts and bridges.

Property owners should understand the legal framework of lease agreements and carefully document all exploration and development activity that takes place on their land.

The Chenango County Farm Bureau has an informative website for property owners considering natural gas lease agreements.

(http://www.ccfbny.org/issues/oil_lease/leasing2.htm)
Landowners with producing gas wells may receive a proportion of the gas produced in addition to a royalty for the gas sold by the operator.

Landowners near a producing well may be allocated some part of the royalty depending on proximity to the well and area of land owned within a defined spacing distance.

Spacing is controlled by the characteristics of the reservoir unit, and is set legally by the NYS Department of Environmental Conservation (NYSDEC).
Natural gas production in Madison County is almost entirely from the Oswego Sandstone-Herkimer Sandstone-Oneida Conglomerate interval.

While there has been much speculation about the potential for natural gas development from the Marcellus Shale, the most likely areas for development are south of Madison County, where the Marcellus is at depths great enough (>1500 feet) to assure reasonable formation pressure and reservoir integrity.

The map on the left shows areas in southern Madison and Chenango County where the Marcellus Shale unit lies at depths great enough (red color contours) for likely development. Areas with green contours have Marcellus Shale at depths less than 1500 feet.

The Utica Shale, another potential shale gas target, underlies all of Madison and Chenango County. No Utica Shale gas has yet been developed in New York or adjacent areas.
Green contours – Marcellus depth less than 1500’ – not appropriate for development.

Bruce Selleck
3/31/09

Marcellus Shale Depth
in Madison and Chenango Counties
in Madison
Marcellus Shale Depth
less than 1500’ – not
Green contours –
Chemung, Chenango, Delaware, Tioga Counties have outstanding permit applications for Marcellus or Utica shale gas exploration. Next — Schoharie, Otsego?
Drilling of a gas well requires construction of a drilling pad and access roads, and moving in and out of heavy equipment. Development of the well may involve installation of casing and cement sheath, and treatment of the producing formation to increase gas flow into the well. The above-ground equipment is not visually obtrusive; pipelines, valves and compressor facilities pose some safety risk. Properly designed and maintained wells do not offer significant environmental hazard.
The Department of Environmental Conservation is responsible for regulating the development and production of oil and gas resources in New York State. Natural gas exploration and production companies, and mineral rights owners, are interested in developing a potentially significant gas resource in the Marcellus Shale through the use of horizontal drilling and a hydraulic fracturing technique known as “slick water fracturing.” This technique requires large volumes of water. The Department has identified the action of well permit issuance when high-volume hydraulic fracturing is proposed as one which requires further review under the State Environmental Quality Review Act (“SEQRA”).

Aspects of high-volume hydraulic fracturing identified in this Final Scope for further review include the potential impacts of (1) water withdrawals, (2) transportation of water to the site, (3) the use of additives in the water to enhance the hydraulic fracturing process, (4) space and facilities required at the well site to ensure proper handling of water and additives, (5) removal of spent fracturing fluid from the well site and its ultimate disposition and (6) potential impacts at well sites where multiple wells will be drilled during a three-year period. Noise, visual and air quality considerations are noted, along with the potential for cumulative and community impacts. The well permitting process is described, and regulatory coordination with other jurisdictional agencies and local governments is also discussed.
Current GEIS guidelines for drilling do not address:

**Large water volumes used in multiple horizontal well hydrofracturing**
(millions of gallons vs. 10’s of thousands in vertical wells)

(hydrofracturing has been used for decades in NYS, however, and horizontal wells have been developed in Trenton and Herkimer reservoirs since 1989)

**Use of ‘slickwater’ fracture fluids**

(slickwater has been used in some recent Herkimer/Oneida reservoir development)

**Expansion of drilling in eastern NYS – Catskill region**

(concerns about impact on NYS water supply and impacts in rugged terrain with scenic value)

**Multiwell drilling pads**

(greater site disturbance; surface and groundwater impacts)
Hydraulic fracturing, fracture fluids and possible water quality impacts

- water based gels and foaming agents
- acids (mainly HCl)
- surfactants
- bactericides
- clay
- iron inhibitors
- friction reducers
- scale and corrosion inhibitors
- etc.

Many of these have been in use in ‘drilling fluid’ and ‘well treatment’ fluids for decades.

New guidelines require complete listing of slickwater components before permit is issued
Potential impacts from slickwater fluid components:

accidental release during transportation to site
release to shallow aquifer systems during high-pressure hydrofracturing
spilling in vicinity of well during well completion
accidental release during removal from site
improper final disposal or reclamation

New guidelines require:

lined pits on site for high volume of fluids
possible use of steel tanks for storage
New guidelines for slickwater fluids require:

- deep well disposal, or
- disposal in approved treatment plant, or
- transport to industrial treatment/reclamation sites

No longer allowed:

- road spreading

Possible:

- Use for enhancement of existing well gas or oil flows
New guidelines will require consideration of:

- noise and visual impacts
- local air quality impacts
- water withdrawal from local streams/aquifers
- surface water quality impacts
- groundwater quality impacts
- roadway impacts
Water quality parameters – the absolute minimum for ‘before and after’

<table>
<thead>
<tr>
<th>Parameters measuring saline water intrusion into aquifer</th>
<th>Parameters measuring gas leakage into aquifer</th>
<th>Parameters measuring well treatment fluid leakage into aquifer</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDS (total dissolved solids)</td>
<td>hydrogen sulfide methane/ethane sulfur oxide species higher hydrocarbons BTEX (aromatic hydrocarbons)</td>
<td>sulfate ammonia nitrate chloride phosphate</td>
</tr>
</tbody>
</table>
Some issues **not** considered:

- health impacts
- requirement for epidemiological studies
- assignment of ‘off-limits’ areas (assessments are ‘site-specific’)
- staffing concerns
- enforcement concerns
- public disclosure of confidential chemical data (?)
for further information

http://offices.colgate.edu/bselleck/NatGas.htm