PLEISTOCENE GEOLOGY, GROUNDWATER, AND LAND USES OF THE TUG HILL, AND BRIDGEWATER FLATS AQUIFERS, ONEIDA COUNTY, NEW YORK: A CASE STUDY

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INTRODUCTION

Due to new national interest in groundwater resources, increased incidents of groundwater pollution, and the lack of an adequate groundwater data base, the Oneida County Planning Department Environmental Management Council in conjunction with Syracuse University and the United States Geological Survey (U.S.G.S.) initiated an evaluation of Oneida County's groundwater resources.

Oneida County (figure 1) is situated within five of the State's major physiographic provinces (figure 2). They are the Adirondack Mountains, the Hudson Mohawk lowlands, the Appalachian plateau, the Tug Hill plateau and the Ontario Lake plain. The present land configuration is a direct result of prior glaciations. The rolling hills, surficial drainage, and valleys are evidence of late Wisconsin glaciation, extensive glaciofluvial erosion, lake impoundment and mass-wasting.

Oneida County is characterized by a dominance of glacial aquifers in a network of transecting glacial troughs with moderate relief and several hundred feet of valley fill. These aquifers are comprised of confined and unconfined sand and gravel glacio- fluvial deposits, glacio-lacustrine deposits and post glacial alluvial deposits.

The groundwater resources of Oneida County have only been slightly studied (Fairchild, 1909; Halber, 1962; Heath, 1964; Kantrowitz, 1970), geologic information has been well documented (Miller, 1909; Kay, 1953; Dale, 1963; Street, 1963; Cadwell, 1972; Wright, 1972; Krall, 1977; Chambers, 1978; Jordan, 1978; Antonetti, 1982; Franzi, 1983).

Most groundwater studies in glaciated areas have been either 'site-specific' or greatly generalized. Neither the generalized and qualitative studies nor the more detailed studies effectively assist planning with respect to the control of groundwater contamination and overdevelopment. The former is too qualitative to accurately locate groundwater recharge and discharge areas, whereas the latter often is too site-specific to have direct transfer value. The research being conducted is a "case study" designed to provide the types of hydro-geological information necessary to evaluate the groundwater resources in glaciated terrains.

A better determination of the types of groundwater flow systems that develop in glaciated areas will provide future planners with information essential to various land use activities such as the location of additional landfills, bulk storage sites, etc.

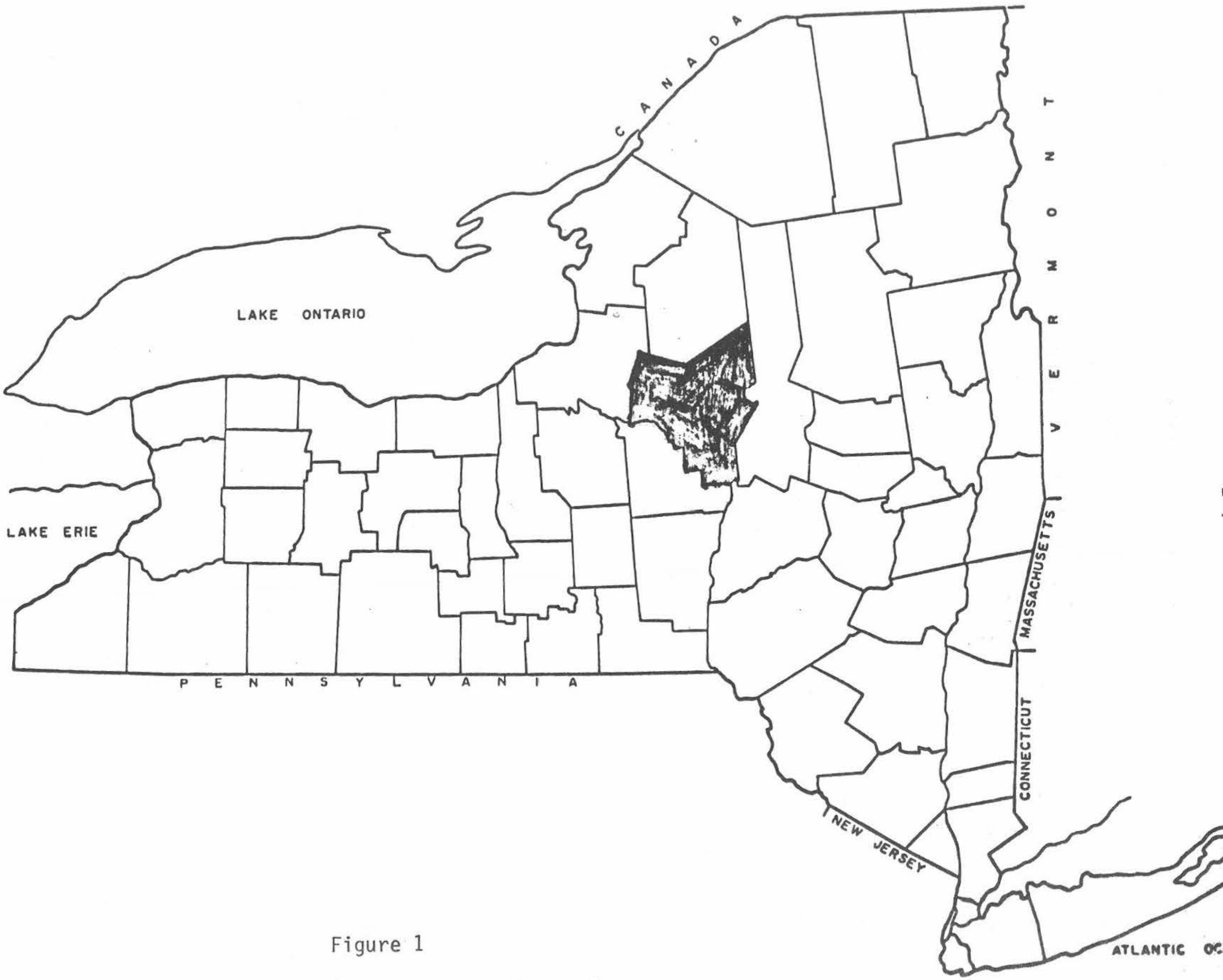

Figure 1

Oneida County, New York

This study qualitatively evaluates the hydrogeology of Oneida County, New York, and simulates, through the use of computer models, the major aquifer systems to determine the main parameters controlling groundwater movement.

The probable boundaries for the major glacial aquifers is being determined by literature evaluation of the glacial geology and interpretation of published and unpublished data from test borings and water-well records. Maps will be prepared of transmissivity, specific yield, the water table, and the potentiometric surfaces of confined aquifers.

Selection of some aquifer boundaries and the determination of the types of groundwater flow systems (regional, local) will be done by numerical simulation by finite-difference computer models. The models (Trescott and Larson, 1976) will be used as a tool to 'test' the sensitivity of groundwater flow systems to aquifer boundary conditions and to determine estimates of material parameters such as hydraulic conductivity.

Twelve aquifers have been tentatively identified in Oneida County but geologic and hydrogeologic data has been mapped and compiled only for the Tug Hill Aquifer. This, and the Bridgewater Flats Aquifer are typical examples of valley fill systems. The studies of these two aquifers is a joint effort of the Planning Department, Syracuse University, and the U.S.G.S.

Tug Hill Aquifer

Setting

The Tug Hill Aquifer occurs along the west and south sides of the Central Tug Hill area (figure 3). The aquifer extends 55 miles from Adams Center (Jefferson County) through Western Oswego County and into Oneida County, where it joins the Rome Sand Plains beyond McConnellsville and Blossvale (figure 4). The aquifer is a typical example of a valley fill aquifer. West Branch Fish Creek runs NW-SE through the center of the valley.

Surficial Geology

Field data indicate that the valley is filled with sand and gravel which grades southward into lacustrine sands. The northern part of the aquifer is comprised of beach sand and gravel and localized pockets of outwash material. Beach sand and gravels can be seen in an excavation pit cut into a beach ridge around Adams Center. Proceeding south through the valley, the beach sand and gravel grade into coarse outwash material. Along the valley walls are extensive deposits of kame terraces, which are believed to influence the recharge into the valley material. Significant quantities of coarse granular sediments comprising a kame moraine complex are found in the reach from Williamstown to Westdale. From Williamstown to Camden, several eskers trending NW-SE, are found along the valley floor. The outwash deposits grade into lacustrine deposits within this area. Proceeding south from Camden to the terminus of the aquifer around McConnellsville, the aquifer is comprised of lacustrine sands. Several well records in the southern portion of the aquifer indicate that sand and gravel overlies till and bedrock at a depth ranging from 90-130 feet. An extensive outwash fan deposited by the Mad River is found at its confluence with the West Branch of Fish Creek Valley. Additional investigation is needed to determine the depth to which this fan material extends.

Hydrology

The Tug Hill Aquifer is recharged by the substantial precipitation resulting from prevailing westerly winds sweeping across Lake Ontario and then encountering the rising Tug Hill Plateau. Recharge occurs from precipitation that falls on the aquifer and seeps to the water table as well as from seepage out of streams crossing or following the aquifer formation.

Several municipal water systems tap the aquifer to supply 6,900 people at a rate of about 1.3 million gallons per day. About the same number of people tap the aquifer through individual wells. The new DEC Salmonid Hatchery at Altmar pumps at peak load 2.3 million gallons per day, and Schoeller Technical Paper pumps on the average 1.5 million gallons per day.

Aquifer yield varies along the length of the aquifer. Kantrowitz, 1970; estimated aquifer yields to range from 2-4 million gallons per day to as much as 12-20 million gallons per day. Two very productive reaches (12-20 mgd) are from Kasoag to south of Westdale and within the Richland quadrangle.

In general, depth to the water table is approximately 20 feet, but, the water table when in close proximity to streams is found to be 2-8 feet below land surface. Throughout the aquifer many shallow dug wells tap the groundwater resource to supply potable water for individual home use. Some reported depths to the water table were as great as 35 feet and 47 feet. Many springs flow year-round along the valley margins.

Further investigation is needed for the Tug Hill Aquifer. The interaction between the West Branch Fish Creek and the aquifer needs to be determined. For many parts of the aquifer, data on saturated thickness is missing. An appraisal of groundwater quality needs to be conducted.

This information will be disseminated to the public for educational purposes, and to State and local bodies of government in order to develop long-term planning and management.

A number of municipal sewage treatment plants discharge wastewater directly into Fish Creek. In addition, several industrial and sanitary disposal sites are located on top of the aquifer. An inventory of the overlying land use needs to be conducted and a variety of strategies are needed to protect these vulnerable, hidden resources from overuse and contamination.

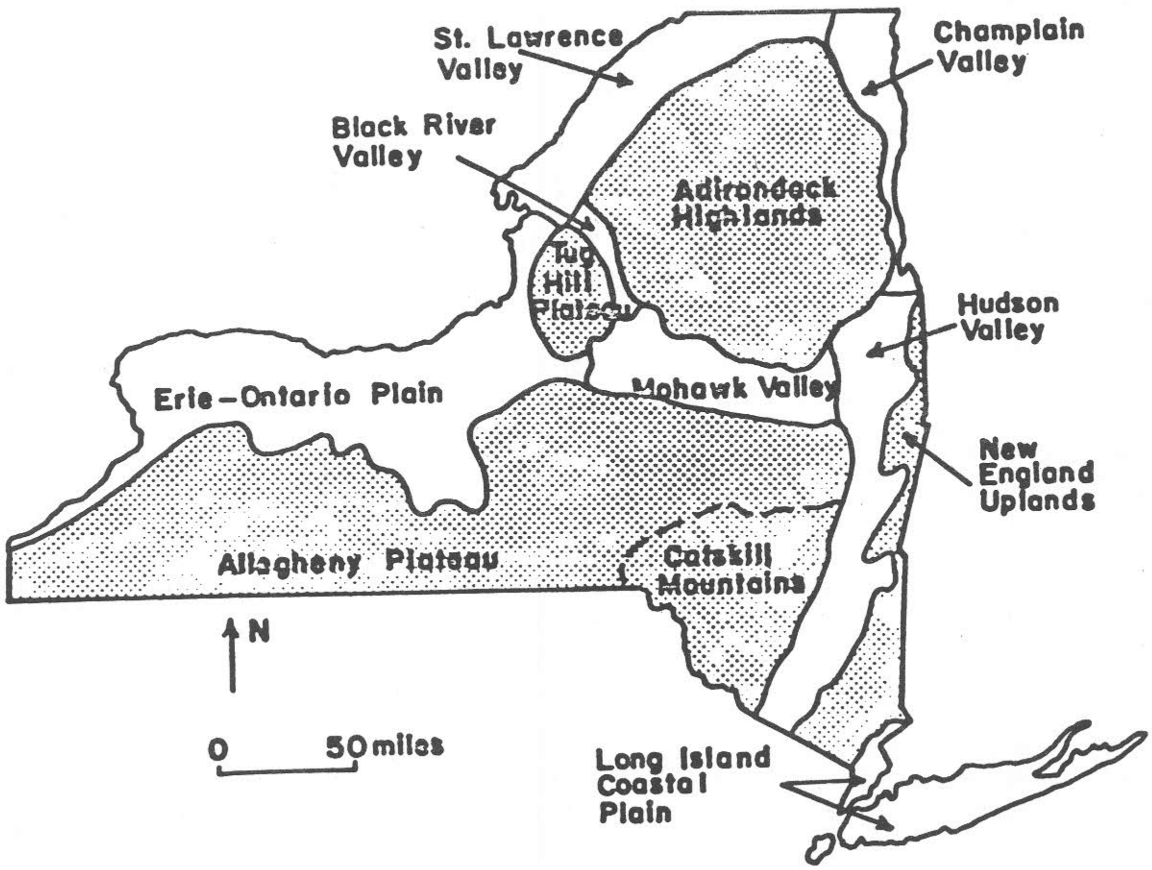

Figure 2. PHYSIOGRAPHIC PROVINCES of New York State (adapted from Olson, 1969).

Figure 3. Tug Hill Plateau

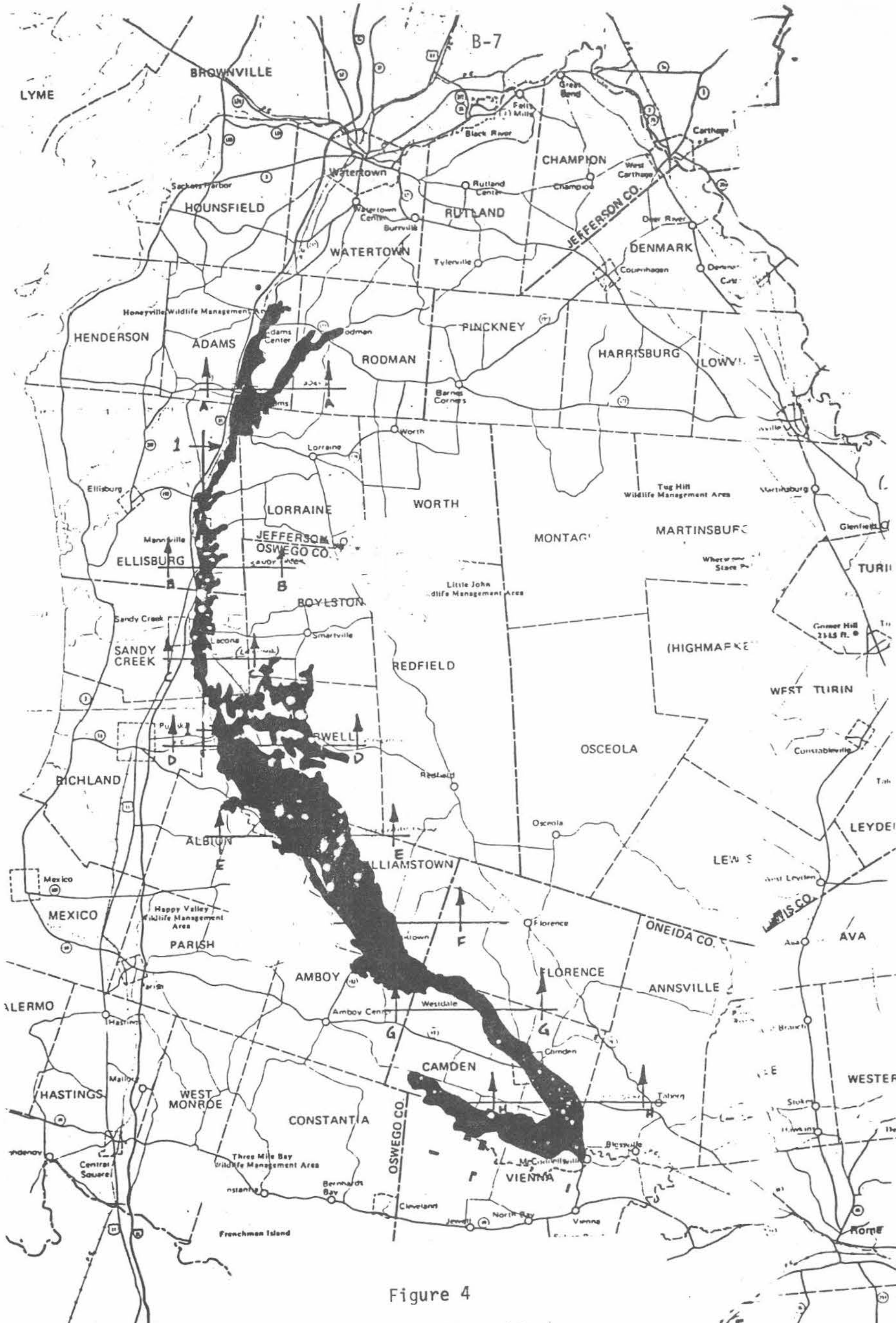

Figure 4

Tug Hill Aquifer

The Bridgewater Flats Aquifer

Setting

The Bridgewater Flats Valley, in southeastern Oneida County, is a typical example of a headwater through-valley (figure 5). The valley is approximately four miles long and one mile wide, at its head, and one-half mile wide at its outlet. It gradually slopes to the south about 60 feet from its head to its outlet. The valley floor slopes to the east, where it has been incised by the West Branch Unadilla River. Drainage north of the divide is to Sauquoit Creek. Drainage to the south is to the West Branch Unadilla River of the Susquehanna River Basin.

Surficial Geology

An analysis of the surficial geology and well records indicate that the valley is partially filled by sandy gravel which thins southward. Gravel exposures can be seen in northern Bridgewater Flats. The greatest known thickness of gravel, 47 feet, is located west of Babcock Hill close to the drainage divide. The surficial sandy gravel deposits grade southward into coarse black sand, silt and clay. Buried gravel is indicated in well logs at well locations near the southern end of the valley. Well logs for the southern end of the valley showed gravel overlain by 16 feet of clay and 22 feet of coarse black sand; another log showed 40 feet of sand. One well was drilled 394 feet through fine sand and bottomed in gravel.

Surficial clay deposits appear sporadically in the valley. The clay is considered to be lacustrine deposits laid down in a proglacial lake over outwash gravels. The southern part of the valley contains an aquifer under confined conditions. It is assumed that the buried gravel in the southern end of the valley is continuous with the surficial gravel in the northern end.

Hydrology

The estimated saturated thickness of the aquifer ranges from 10 to 40 feet at depths less than 50 feet (Hollyday, 1969). Estimated well yields (Hollyday, 1969) could range from 550 to 2,400 gal/min with a median of 1,000 gal/min. In general, the water table lies within a few feet of the land surface.

The aquifer is recharged by direct precipitation and runoff. Two major tributaries on the west side of the valley contribute recharge to the aquifer throughout the year. Kame deposits on the west side of the valley allow for very rapid infiltration of precipitation to recharge the valley deposits. The east side of the valley is underlain by a bedrock bench. Unconsolidated material covering the bedrock are mixed ice - contact and till deposits.

Land Use

The predominant land uses in the Bridgewater Flats valley are dairy farming, commercial potato and vegetable farming, cash cropping and corn

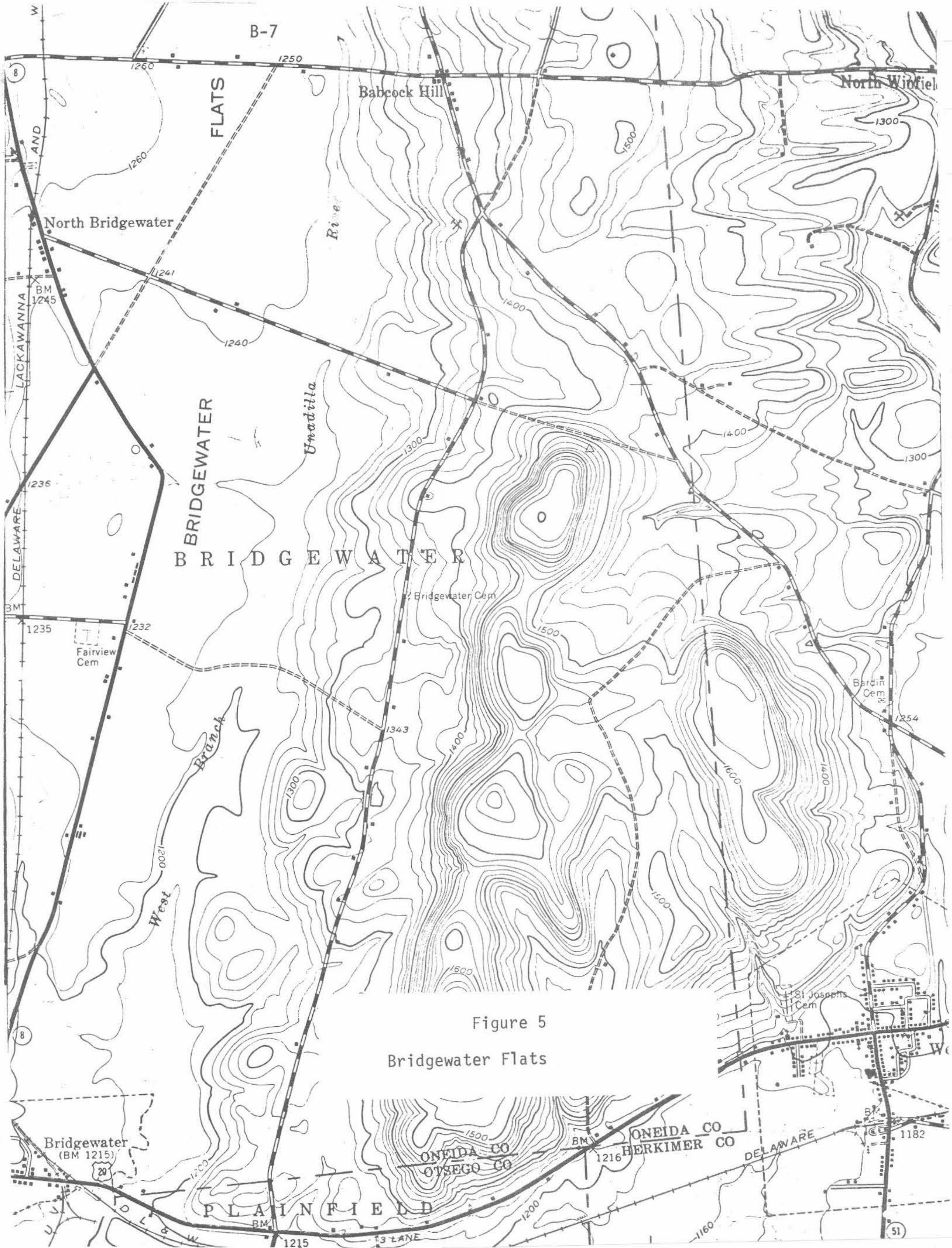

Figure 5

Bridgewater Flats

plantings for grain and silage. Commercial fertilizers and manure are applied to the soils for maximizing crop production. Therefore, nitrate loading to the groundwater may adversely impact water quality. However, at the present time, there is not extensive residential development. Homeowners, however, utilize individual water well supplies and have conventional on-site septic tank systems. The greatest potential for groundwater contamination is from the development of mobile home parks which utilize on-site conventional septic tank systems. Evaluation of adequate soil conditions and construction of alternative septic tanks and leach fields will minimize the risk of groundwater pollution from nitrates.

Further investigation on the Bridgewater Flats aquifer is being conducted. The degree to which the aquifer is connected to the West Branch Unadilla River must be determined. Recharge areas must be adequately defined, especially recharge to the confined aquifer in the southern end of the valley. Recharge rates and natural groundwater discharge areas and rates need to be determined in order to minimize the risk of overdevelopment in the future. This information will also reduce the number of poorly located, deep, costly wells. In general, the groundwater resources here have met the demands placed upon them, and appear to be ample to meet future needs.