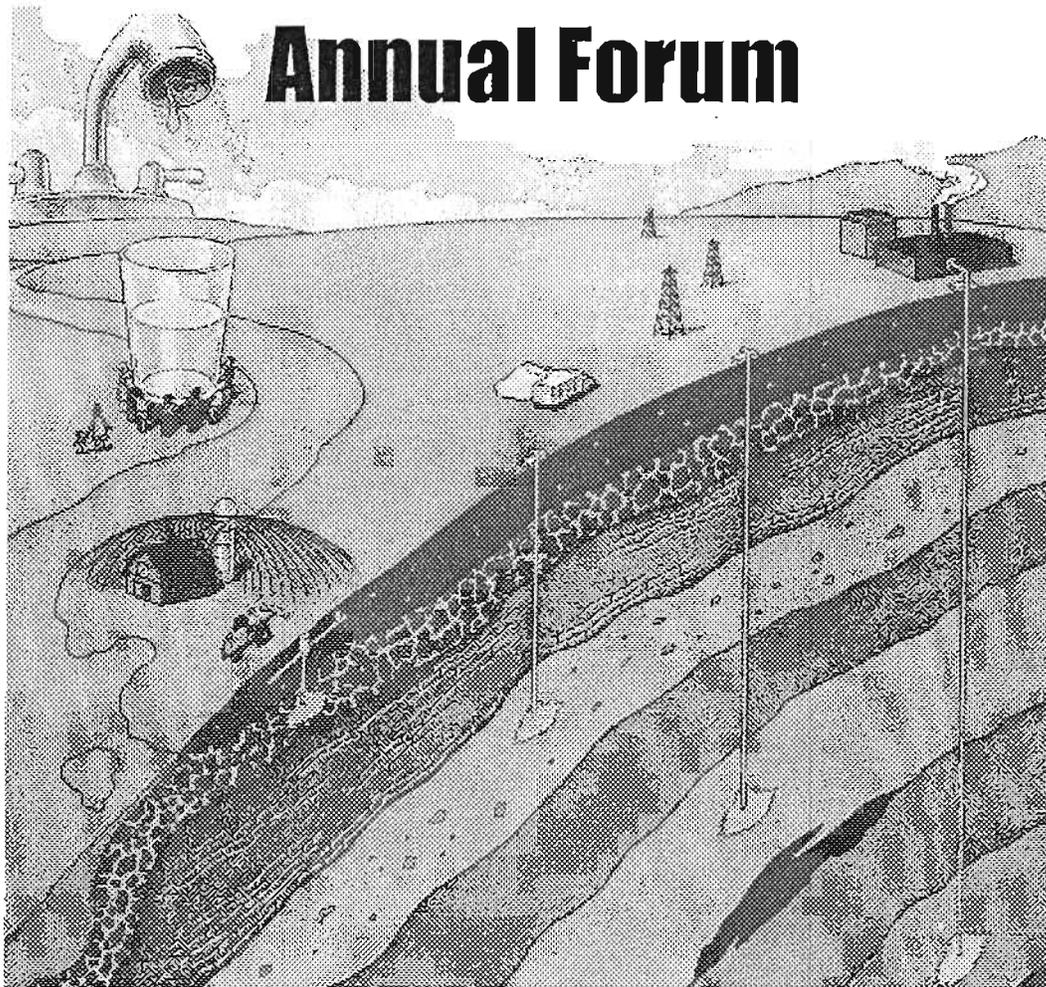


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DEVELOPMENT OF NEW YORK'S SOLUTION SALT MINING REGULATORY PROGRAM

Kathleen F. Sanford

**Division of Mineral Resources
New York State Department of Environmental Conservation
50 Wolf Road, Room 290
Albany, NY 12233-6500**

ABSTRACT

New York's current solution mining regulatory program was founded in 1973 when the oil and gas law was amended to include solution mining wells. Prior to this legislation, the scope of state knowledge regarding solution mining facilities was extremely limited. State involvement in review and approval of well drilling and plugging proposals increased after 1973, but cavern development operations and well abandonments continued to occur with little state oversight. At the end of 1973, there were 250 unplugged solution mining wells at six facilities, including five active operations and one shut down in 1962. No more than 60 wells were in use, leaving at least 190 that had been abandoned but not plugged. By 1973, five sinkholes had formed in the Tully Valley brine field in Onondaga County, where 156 abandoned wells were located.

Higher drilling fees imposed in 1981 allowed the state to add staff and increase oversight of solution mining operations. Reconnaissance inspections in 1984 revealed the problems in Tully Valley; thus, the early emphasis of the state program was on enforcement and remediation efforts at this single facility. Production ceased in Tully Valley in 1988; well plugging began in 1989 and was completed in 1995.

Since 1993 New York's program has been redirected at establishing an appropriate level of involvement with active solution mining operations to ensure environmentally sound development of the state's salt resource. Accomplishments have included comprehensive field inspections, development of a shut-in well program, and enhanced annual reporting. Currently underway is an effort to eliminate duplication of the EPA-implemented UIC program and strengthen aspects of the state program that are not completely addressed under UIC. Ensuring stability of solution-mined caverns during installation and development is the primary focus of this regulatory reassessment phase.

INTRODUCTION

The state of New York enacted legislation in 1973 that amended the oil and gas law to include solution mining wells. The state had previously proposed to regulate solution mining in a bill that targeted the hard rock mining industry. However, the solution mining industry opposed this idea and requested that its activities be addressed by a separate amendment to the oil and gas law. The resulting bill was supported by the solution mining industry, the Solution Mining Research Institute, and the New York State Geologist. Upon enactment of these amendments, solution mining operators were subjected to the same requirements as oil and gas operators with respect to financial security and well permitting, drilling and plugging. These requirements applied to individual wells; overall facility operations such as cavern development continued to be conducted with no state oversight.

Table 1 compares the status of the solution mining industry in New York in 1973, the year the amendments were enacted, to 1995. Only those facilities where some activity has taken place since 1973 are tabulated. ("Activity" in this context includes drilling, production, or plugging. Plugging is the only activity that occurred at International Salt's Lansing facility after 1973.) Thirty-four small solution mining facilities in addition to the seven tabulated are known to have existed in New York, with 85 solution mining wells known to have been drilled between 1878 and 1917. Most of these early facilities were abandoned before 1917 and the status of many of the wells is unknown. The only solution mining wells currently in use in New York are located at five of the seven facilities included in Table 1. Locations of these facilities are shown on Figure 1. While the total number of wells in use has doubled since 1973, the number of plugged wells at the tabulated facilities has increased ten-fold and the number of unplugged abandoned wells has decreased to zero.

Table 1. Status of Solution Mining Facilities* in New York, 1973 vs. 1995 (year-end)

	1973	1995
Solution Mining Wells In Use**	60	122
Plugged Solution Mining Wells	32	348
Unplugged, Abandoned Solution Mining Wells	190	0

***Facilities**

- 1973: International Salt (now Akzo Nobel) Watkins Glen & Lansing, Watkins Salt Company (now Cargill) Watkins Glen, Allied Chemical (now AlliedSignal) Tully Valley, Morton Silver Springs, Texas Brine Dale
 1995: all 1973 facilities plus Texas Brine Wyoming Village

**Wells in use include non-abandoned inactive ("standby") wells.

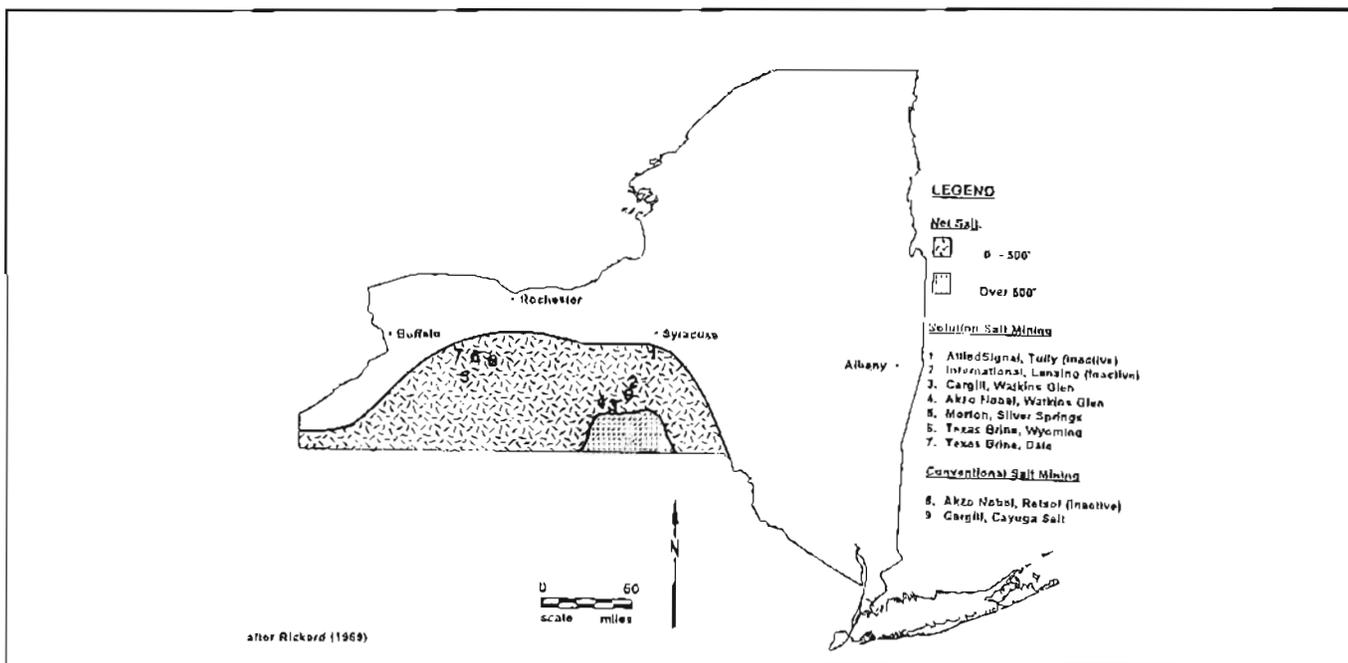


Figure 1. Silurian salt and mines in New York State.

Figure 2 depicts trends in New York brine production since 1984, when the state began collecting solution mining production data. Brine withdrawal through solution mining wells increased 71 percent during the five-year period ending with 1994. Figure 3 illustrates the significant contribution solution mining wells make to New York's overall salt production, assuming that all brine withdrawn was 100% saturated. Figure 4 shows that, based on statistics compiled by the U.S. Geological Survey for 1994, New York ranks third among the states in total salt production and first in market value of salt produced.

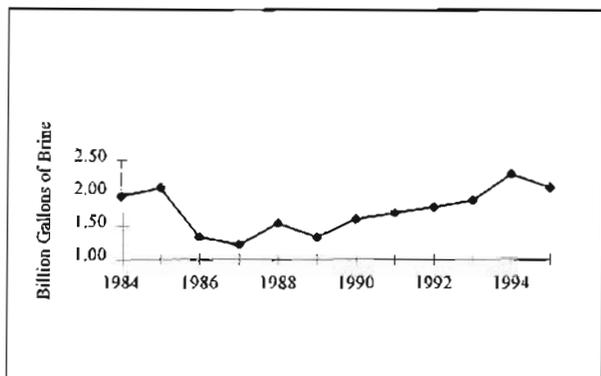


Figure 2. Brine produced through solution mining in New York State.

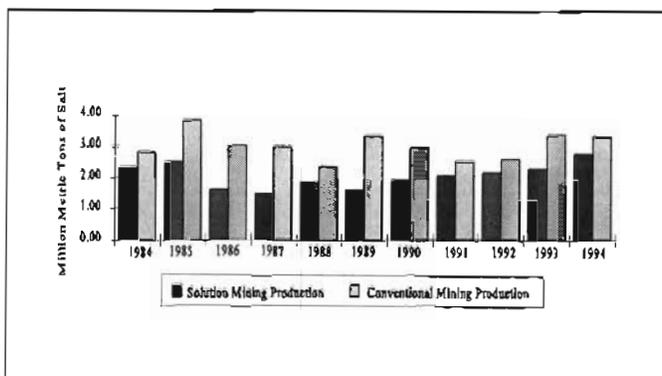


Figure 3. New York State salt production, 1984-1994.

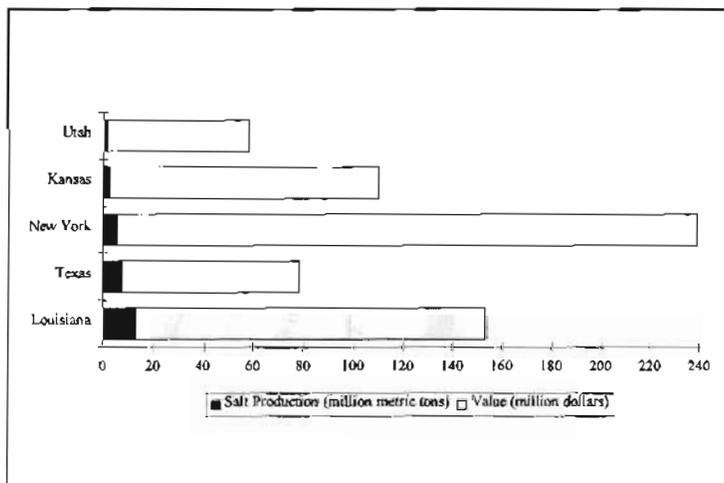


Figure 4. 1994 salt production and value, top five states. (includes all methods of production; all data from USGS)

PROGRAM HISTORY

Although the 1973 legislation gave the Department of Environmental Conservation the authority to promulgate regulations to assert its jurisdiction over solution mining, the Department has not yet formally done so. Solution mining operations have instead been regulated through application of appropriate citations to the oil and gas rules. The oil and gas rules and regulations do not contain provisions that address cavern development operations, and state regulatory personnel initially focused on oversight of well drilling and construction activities.

Increased fees for drilling permits were authorized in 1981 by an amendment to the oil, gas and solution mining law. These new fees provided funding for the Division of Mineral Resources to add staff both in the Albany office and two western New York field offices. The most urgent priority of the Division at this time was oversight of the intense oil and gas drilling activity that occurred in the early 1980's. Although field staff continued to conduct site inspections related to permitting, drilling and plugging of individual solution mining wells, it was not until 1984 that Division staff could schedule overall facility inspections.

Division of Mineral Resources staff have in recent years become increasingly involved in review and approval of cavern development proposals. Factors that have influenced the evolution of New York's solution salt mining regulatory program since 1973 include:

- 1) the state's decision not to accept primacy for the Underground Injection Control program;
- 2) passage of the State Environmental Quality Review Act and publication of the Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program;
- 3) the adverse environmental impacts of solution mining in Tully Valley;
- 4) the compliance records of the active operators and absence of adverse impacts at their facilities; and
- 5) the collapse and flooding of the Retsof conventional salt mine.

The Primacy Decision

New York chose not to take primacy for implementation of the Underground Injection Control (UIC) provisions of the federal Safe Drinking Water Act. This decision was based on both an in-house review and a consultant's study, which concluded in 1982 that assumption of primacy would accrue minimal or no environmental benefits, but at considerable cost. Therefore, the EPA has the responsibility for administering the UIC permitting program and regulating injection operations at solution mining facilities in New York. The EPA in late 1985 and early 1986 issued permits to all five facilities that are now active. The Tully Valley brine field was also active when the UIC program took effect, but the EPA did not require a permit because there were no injection wells at that facility.

The State Environmental Quality Review Act and the Generic Environmental Impact Statement

Regulations implementing New York's State Environmental Quality Review Act (SEQR) were promulgated in 1978. The SEQR regulations require all state and local government agencies to consider the environmental significance of any actions they approve, fund or directly undertake. Any action deemed "environmentally significant" must be further evaluated in the context of an environmental impact statement. Generic environmental impact statements (GEIS) are used to consider broad-based actions such as application of a regulatory or permit program.

The Division of Mineral Resources issued a draft GEIS on the state's oil, gas and solution mining regulatory program in 1988 and a final GEIS in 1992. The major finding of the GEIS was that the permitting of any individual well covered by the regulatory program is a non-significant action under SEQR. As a result of this finding, operators are not required to prepare separate environmental impact statements for individual wells that conform to the law, the rules and regulations, and existing guidelines and standard permit conditions. However, the GEIS also found that permitting of new solution mining projects or major modifications of existing projects may have significant environmental impacts. Consequently, any proposed new project or major modification must undergo a site-specific environmental assessment and, based on the results of the assessment, may require preparation of an environmental impact statement to supplement the GEIS.

The GEIS was also used to recommend revisions to the overall oil, gas and solution mining regulations. One of the primary recommendations affecting solution mining was that wording be added to clearly state that most of the general regulations pertaining to well siting, drilling, well construction, plugging, and reporting apply to solution mining along with oil and gas. The GEIS also included additional

recommendations specific to solution mining projects. Among these were requirements for cavern setbacks - from property lines, subsidence and groundwater monitoring plans, and a final project abandonment report.

Upon finalization of the GEIS and its findings, therefore, Division of Mineral Resources staff involved in oversight of solution mining operations began to develop regulations. The programmatic goals were twofold: 1) to define the conditions under which a proposal for a new project or major modification may have sufficient environmental impact to require a supplemental environmental impact statement, and 2) to incorporate the recommendations for specific regulations contained within the GEIS.

Tully Valley

For nearly a century, the Tully Valley brine field in Onondaga County was the largest solution mining operation in the state, both in terms of number of wells drilled and volume of brine produced. Solvay Process Company started development of the field in 1888 to supply its soda ash plant near Syracuse. Solvay Process Company and its successor, Allied Chemical Corporation (later AlliedSignal, Inc.), used completion and cavern development methods that resulted in sinkholes, widespread general subsidence, and alteration of the valley's hydrology. Furthermore, wells were routinely left unplugged when no longer needed or used.

Staff of the Division of Mineral Resources began to learn about the problems in Tully Valley in 1983 when the company applied for permits to drill two new wells and in 1984 when the first statewide solution mining facility inspections were conducted. Two years later, in 1986, Allied announced the permanent closure of the soda ash plant and the sale of four wells to another operator. The remaining 168 wells were to be abandoned, with the operator proposing to plug only 20 in accordance with state law. The four sold wells were abandoned, but not plugged, in 1988.

The problems in Tully Valley affected the development of New York's solution mining regulatory program in two ways:

- 1) Limited staff resources were diverted from regulatory development to the Tully Valley well plugging enforcement initiative and the investigation of known and suspected impacts of solution mining in Tully Valley.
- 2) Staff focused on prevention of Tully-type problems as a major goal of developing regulations.

Compliance Records of Existing Facilities

The Tully Valley enforcement initiative was successfully concluded in 1992 when AlliedSignal agreed to plug all wells in accordance with the objectives of the well plugging provisions of the Oil, Gas and Solution Mining Law. The Division could then concentrate on assessing the compliance status of the remaining facilities. For the first time since 1984, staff conducted overall facility inspections. These inspections, completed in October 1993, were more comprehensive than the earlier ones and resulted in both heightened rapport with the operators and increased understanding of the operations.

The primary finding of the 1993 inspections was that Tully-type problems do not exist at any of the currently active solution mining facilities in New York, even though three of the five fields have been in

continuous operation since before the turn of the century. Division staff observed no sinkholes or other subsidence damage at any of the five facilities. Current solution mining operations in New York are not known to have caused any adverse impacts to groundwater resources. The existing operators, all of whom hold federal UIC Class III permits, meet modern standards with respect to well construction, cavern development, and well plugging.

Division staff made recommendations for enhanced environmental protection to each operator as a result of the 1993 inspections, and the operators made many of the suggested improvements within one year of the inspections. These improvements included more frequent visual wellhead inspections, plugging of unused wells, remediation of inadequate fluid storage or handling structures, removal of debris and scrap equipment, installation of wellsite identification signs and more accurate reporting.

Remaining matters of concern after the 1993 inspections included reporting and tracking of inactive standby wells and the general adequacy of spill prevention, leak detection, and fluid containment measures at some facilities.

Collapse and Flooding of the Retsof Conventional Salt Mine

The Retsof mine, located in Livingston County, suffered a partial collapse in March 1994 which ultimately resulted in flooding and abandonment of the entire mine. Impacts included accelerated subsidence, including sinkholes, over the collapsed portion of the mine and significant aquifer drawdown which caused a number of water wells in the affected area to go dry. This event resulted in increased scrutiny of the state's role in regulating underground mines, particularly with respect to mining methods, extraction ratios, mine stability, and prevention of subsidence damage. The Division of Mineral Resources recommended legislation to create an underground mining regulatory program, and the Governor proposed such legislation in 1996. In addition, the Division in 1996 issued a permit for a proposed replacement salt mine that incorporated requirements for state review and approval of mining methods as well as extensive monitoring and reporting of in-mine rock behavior and surface subsidence.

Staff from the solution mining program were involved in both review of Retsof mine remediation and closure proposals and development of permit conditions for the new mine. During the course of these efforts, staff recognized the similarity in potential adverse impacts of conventional salt mining and solution mining. "Extraction ratios" for solution mining are typically much lower than for rock mining, and brine in solutioned caverns provides some measure of hydraulic support for the overlying rocks. Nevertheless, cavern stability is the key element in preventing subsidence damage and groundwater impacts at both underground rock mines and brine fields. Thus, the Retsof mine collapse affected development of New York's solution mining regulatory program by further focussing staff's attention on the importance of creation and development of stable underground caverns.

CHANGING FOCUS OF THE REGULATORY PROGRAM

Between 1973 and 1984, New York's solution salt mining regulatory program was characterized by emphasis on compliance with well drilling, construction, and plugging regulations. During the program's second decade (1984-1993), staff focused on the Tully Valley enforcement project and development of a full-blown regulatory program to meet the goals of SEQR and the GEIS and to prevent Tully-type problems elsewhere. Division staff also conducted parallel reviews of UIC permit modification proposals (e.g., oil-padding, injection stream modification) during this time period, requiring operators to obtain state approval

as well as EPA approval to modify activities covered by the EPA permits. Operators complied with the state approval requirement even though no formal regulatory program or state facility permits were in place.

The third decade of New York's solution salt mining regulatory program commenced in 1993 with a three-phase reevaluation of the program and its focus.

Phase 1 - Facility Assessment

Phase 1 was initiated in October 1993 with the facility inspections. The inspections focused on general operations at each facility, including cavern development methods, inspection and leak prevention/detection procedures, spill containment, use of standby wells, injection fluid source and composition, and subsidence and groundwater monitoring protocols. A direct result of the inspections was development of an improved annual reporting form, first used for the 1994 reporting year, that allows the operators to provide the Division with updated information regarding many of these aspects of their operations. The Division now also requests that operators submit updated maps showing well locations and cavern boundaries with the annual reports. All New York operators have complied with the new reporting requirements.

Prior to the 1993 inspections, Division staff were concerned with the number of inactive wells reported each year at each facility. Existing regulations require plugging or reactivation of all oil, gas, or solution mining wells shut-in for longer than one year unless the operator shows sufficient good cause and the Division approves continued shut-in status. All inactive solution mining wells were included in the inspections and each operator was interviewed regarding the reasons for maintaining shut-in wells. These discussions and subsequent correspondence revealed that circumstances unique to the solution mining industry warrant approval of shut-in status for more than one year. Types of shut-in wells at solution mining facilities include wells which have not yet connected to galleries, wells for which EPA or other government approval is pending, wells maintained in shut-in status to provide backup supply to the plant if an active gallery must be shut down, and former injection wells which may feasibly connect to adjacent galleries for use as withdrawal wells.

In early 1996, the Division finalized a shut-in well program specific to the solution mining industry that fosters operators' compliance with the requirement to show sufficient good cause for maintaining shut-in wells. Key elements for Division approval of continued shut-in status are a demonstration that salt reserves exist which are recoverable through future use of the well, and certification that the wellhead is regularly inspected and maintained. Furthermore, the Division will not approve shut-in status for wells that are not in compliance with EPA Mechanical Integrity Testing requirements. By mid-1996, all unplugged wells at solution mining facilities in New York were either used during the previous reporting year or shut-in in accordance with the program.

Phase 2 - Assessment of Current Regulatory Framework

Phase 2 of the program reevaluation is summarized in an internal Division report (Briggs, 1995) which identified twenty-five solution mining activities with some level of regulatory involvement by the state, the EPA, or both. Table 2 indicates current levels of involvement and the Division's proposed future regulatory involvement for each of these activities. Division of Mineral Resources jurisdiction for many of the items listed in Table 2 exists not in specific regulations but under the broad authority granted by the Oil, Gas and Solution Mining Law.

It is readily apparent from Table 2 that state regulations and facility permits to govern 24 of the 25 solution mining activities identified by Briggs (1995) would have been extremely duplicative of the federal UIC program. All the dually regulated activities are downhole, reflecting the UIC program's emphasis on protection of Underground Sources of Drinking Water (USDW) (Briggs, 1995).

Phase 3 - Increasing Efficiency and Decreasing Duplication

Upon completion of phase 2, Division staff took the position that regulations should not be duplicative, but instead should supplement the federal program, closing any existing regulatory gaps. Phase 3 resulted in development of draft regulations which address only those issues that meet one of the following criteria:

- 1) The activity is solely state-regulated or the existing state program is more comprehensive.
- 2) The existing federal program does not completely meet the state's goals.

New York's goals for its solution mining regulatory program are as follows:

- 1) to meet the objectives of SEQR and the GEIS, ensuring that proposed solution mining activities undergo environmental review adequate to protect the state's citizens and natural resources,
- 2) to effectively supplement the EPA program with a minimum of duplication,
- 3) to maintain consistency with the state's program for preventing potential surface subsidence and groundwater impacts associated conventional underground salt mining, and
- 4) to assist operators in achieving compliance with all state and federal requirements.

Table 2 shows that the existing state program is more comprehensive for the following activities: well construction, shut-in/temporary abandonment of wells, well plugging, and reporting. Well construction and well plugging are addressed in general regulations that apply to all oil, gas, solution mining and other wells under Division of Mineral Resources jurisdiction. These regulations are undergoing revision and updating concurrently with development of the solution mining regulations. Shut-in/temporary abandonment of wells and reporting are addressed by the previously discussed shut-in well program and revised annual reporting forms.

Division staff concluded that the existing federal program does not meet the state's goals with respect to regulating activities related to the creation and monitoring of stable caverns, including subsidence monitoring. The emphasis of the federal program is on protecting USDW's through area of review requirements, mechanical integrity testing, and injection pressure limitations. Because of the effectiveness of the federal program, state regulations will not address these issues. Instead, the state program will focus on stable cavern development as the key to the goal of subsidence prevention and protection of groundwater resources from subsidence-related impacts.

CURRENT STATUS OF NEW YORK'S SOLUTION SALT MINING REGULATORY PROGRAM

The proposed solution mining regulations will include a statement that operators must conduct all solution mining activities in a manner that ensures underground cavern stability and prevents catastrophic or damaging subsidence. Requirements to achieve this goal will include:

Table 2. Regulated Solution Mining Activities

Activity	State-Regulated (Division of Mineral Resources)	State-Regulated (Other Divisions or Agencies)	EPA-Regulated	Proposed for Future Regulation by Division of Mineral Resources
Installation of wellsite identification signs	✓			✓
Well drilling and surface siting	✓			✓
Well construction	✓		✓	✓†
Surface/groundwater withdrawal		✓		
Well hydrofracing			✓	
Shut-in/temporary abandonment of wells	✓		✓	✓†
Well plugging	✓		✓	✓†
Wellsite reclamation	✓			✓
Creation of stable caverns (design)	✓*		✓*	✓
Creation of stable caverns (development)				✓
Limiting cavern to within mineral rights	✓			✓
Brine storage in tanks/reservoirs		✓		
Cavern fluid level monitoring	✓		✓	
Injection into wells for solutioning	✓		✓	
Injection into wells for solids disposal	✓		✓	
Brine withdrawal	✓			✓
Roof-paddng (surface & downhole)	✓		✓(downhole only)	✓(surface only)
In-field transport of brine/injection fluid		✓		
Brine pipelines		✓		
Reporting of injection/withdrawal volumes	✓		✓	✓†
Groundwater monitoring			✓	
Subsidence monitoring	✓		✓*	✓
Seismic monitoring	✓*			✓
Brine field housekeeping	✓			✓
Inspection of previously plugged wells	✓			✓

* Division staff concluded that requirements are minimal or imposed only on a case-by-case basis.

† Division staff concluded that current Division of Mineral Resources involvement exceeds federal involvement.

- 1) Division review and approval of cavern development methods,
- 2) timely subsidence monitoring and reporting in accordance with regulatory standards,
- 3) annual delineation of cavern limits,
- 4) Division authority to require cavern delineation and/or a corrective action plan at any time based on cavern stability issues, mineral rights boundary issues, or non-routine incidents including subsidence,
- 5) Division review and approval of any corrective action plan proposed to remediate potential or actual sinkhole formation or other surface or subsurface damage, and
- 6) suspension of operation of any well(s) associated with sinkhole formation or other surface or subsurface damage.

Solution mining regulatory development was undertaken as part of an overall revision of the entire body of oil, gas, and solution mining regulations. The Division currently anticipates that the complete package will be available for public review and comment in 1997.

Until the new regulations are formally adopted, Division staff will continue to use the broad authority of the Oil, Gas, and Solution Mining Law to review and approve solution mining activities as proposals are made. However, in order to immediately reduce duplication with the EPA program, future state review and approval requirements will focus only on those activities proposed for formal regulation.

SUMMARY

New York's solution salt mining regulatory program has been a "work-in-progress" for many years. Division of Mineral Resources staff involved in the regulatory program have strived to create a program that effectively meets the state's environmental goals and legislative mandates while accommodating the unique needs of the solution mining industry. Steps completed towards accomplishing this objective have included comprehensive field inspections, enhanced annual reporting, development of a shut-in well program, and recommendations for the program's future direction that minimize duplication with the federal UIC program. The planned regulatory revision will ensure the citizens of New York that solution mining operations will be conducted under adequate oversight to ensure the creation and development of stable underground caverns.

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