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Synthesis and Perspectives

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10.1 Impact of the Soda Ash/Chlor-alkali Facility on Onondaga Lake and Adjoining Systems: Update

10.1.1 Background

In late 1985 and early 1986 an analysis of the impact of the soda ash/chlor-alkali facility on Onondaga Lake and adjoining systems was conducted by Effler (1987) in anticipation of the closure of the plant. Effects of the ionic waste discharge of the facility identified (Effler 1987), included: (1) ionic enrichment, (2) altered stratification regime of the lake, (3) altered exchange between the lake and river, (4) altered hydrodynamics in the river downstream of the lake, (5) precipitation and deposition of large quantities of CaCO₃, and (6) altered chemistry of lake sediments regulating P availability. It was concluded (Effler 1987) that mercury and benzene and chlorobenzene wastes from the facility had contaminated the lake sediments and fish of the lake. Deleterious impacts of the facility identified by Effler (1987) included: the elimination of fish habitat, exacerbation of the problem of limited O₂ resources of the lake, contamination of fish flesh, exacerbation of the problem of low transparency of the lake, and severe O₂ depletion in the lower waters of the river system.

Documented changes in related characteristics of the lake and adjoining portions of the Seneca River brought about by reductions in waste loading that accompanied the closure of the facility (February 1986), and continued research on related lake processes, as described in earlier chapters, offer an excellent opportunity to update the impact analysis. Shortcomings in previous interpretations are also identified. It is emphasized that this should be considered an update, rather than a final postaudit analysis of the facility’s impact, as related research continues.

10.1.2 Ionic and Ammonia Waste Loading

An abrupt decrease in ionic waste loading occurred as a result of the closure of the soda ash/chlor-alkali plant (Chapter 3). The average annual summed load of Cl⁻, Na⁺, and Ca²⁺, the major ionic waste constituents, for the 1974–1985 interval (i.e., before closure) was 1.2 × 10⁹ kg, corresponding to a daily average loading rate of 3.3 × 10⁶ kg · d⁻¹. By 1989 the summed load was 0.14 × 10⁹ kg, or about 12% of the preclosure load. By 1989 the annual loading of Cl⁻, Na⁺, and Ca²⁺ had decreased by 79, 67, and 70% from the average.
documented for the 1974–1985 period (Chapter 3), as a result of the closure. The plant was the single largest source of Cl\(^-\) to Lake Ontario before it closed (Effler et al. 1985a). During the 1970s this facility contributed 48, 37, and 10% of the U.S. tributary, total tributary, and grand total Cl\(^-\) loading, respectively, to Lake Ontario.

The substantial residual of ionic waste loading that has continued (Chapters 2 and 3) following closure was not anticipated by Effler (1987); thus, related impacts identified in that earlier analysis have been ameliorated, but not eliminated. Most of the ionic waste from soda ash manufacture that continues to be released enters Ninemile Creek in the area of the most recently active waste beds. This is manifested as dramatic increases in Cl\(^-\), Na\(^+\), and Ca\(^{2+}\) concentrations downstream of the waste beds (Lakeland station, e.g., Effler et al. 1991, Chapter 3) and the constant relationships maintained among these three constituents in the stream below the beds (Chapters 2 and 3). The average Cl\(^-\) concentration at Amboy (located on Ninemile Creek upstream of the waste beds) was less than 7% (54 mg \(\cdot\) L\(^{-1}\)) of the average observed at Lakeland (821 mg \(\cdot\) L\(^{-1}\)), over a 12-month interval in 1989 and 1990 (Effler et al. 1991). A strong relationship exists between Cl\(^-\) (and Na\(^+\) and Ca\(^{2+}\)) concentration and flow (“dilution model”) at the Lakeland station (Chapter 3), consistent with a load that emanates largely as leachate and contaminated ground water. The relationships between the three primary ionic constituents in the creek below the beds continue to be essentially equivalent to those of the Solvay waste bed overflow during the operation of the facility (Chapters 2 and 3), establishing the origin of these constituents as waste generated from soda ash production. The ionic waste from soda ash production also continues to enter the lake via METRO, associated with irregular reception of enriched water from a lagoon adjoining the waste beds that continues to fill. Approximately 55% (50% from Ninemile Creek and 5% from METRO) of the total external Cl\(^-\) load that continues to be received by Onondaga Lake has its origins as soda ash waste (Chapter 3).

The estimates for Na\(^+\) and Ca\(^{2+}\) are somewhat less certain, about 42 and 30%, respectively (Chapter 3).

Effler et al. (1991) also found a significant load of T-NH\(_3\) enters Ninemile Creek in the area of the most recent waste beds. The concentrations of T-NH\(_3\) and Cl\(^-\) were highly correlated in the creek, implying the same origin(s) for these constituents (Effler et al. 1991). Ammonia, an important intermediary reactant in the Solvay process, was largely recycled. However, this recently discovered load indicates the recovery of T-NH\(_3\) was incomplete. This source of T-NH\(_3\) presently represents only about 3% of the total external load (Effler et al. 1991). However, it would probably represent the single largest source of T-NH\(_3\) to the lake if METRO were diverted. This source is not critical to meeting the free ammonia standard for the lake for non-salmonids, but it could be critical if a salmonid goal for the lake was established (see Chapter 9).

The “mud boils,” located along Onondaga Creek (33 km upstream of the lake) in Tully Valley, had not been identified as a potential impact of the soda ash/chlor-alkali facility by Effler (1987). The occurrence of the “mud boils” (effusion of soft sediment brought to the surface by artesian discharge (Shilts 1978)) has been attributed (Getchell 1983) to solution mining activities at nearby evaporite (NaCl) deposits by the soda ash manufacturer. However, there is continuing contention concerning this issue (e.g., Kosinski 1985; Tully 1983). The “mud boils” are a significant source of sediment (Effler et al. 1992) to the lake, as well as Cl\(^-\) and Na\(^+\) (Chapter 3). Approximately 8% of the present total external Cl\(^-\) load and 10% of the Na\(^+\) load are supplied from the “mud boils”. Thus the soda ash facility may be responsible for more than 60% of the continuing Cl\(^-\) load and more than 50% of the Na\(^+\) load (Chapter 3). Breaks in the brine line (not previously identified by Effler (1987), that extends from Tully Valley to the facility on the western shore of the lake, have caused short-term increases in Cl\(^-\) and Na\(^+\) concentrations and related fish kills in Onondaga Creek.