New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233-3508

Michael D. Zagata
Commissioner

MEMORANDUM

*****NOTICE*****
This document has been developed to provide Department staff with guidance on how to ensure compliance with statutory and regulatory requirements, including case law interpretations, and to provide consistent treatment of similar situations. This document may also be used by the public to gain technical guidance and insight regarding how the department staff may analyze an issue and factors in their consideration of particular facts and circumstances. This guidance document is not a fixed rule under the State Administrative Procedure Act section 102(2)(a)(i). Furthermore, nothing set forth herein prevents staff from varying from this guidance as the specific facts and circumstances may dictate, provided staff's actions comply with applicable statutory and regulatory requirements. This document does not create any enforceable rights for the benefit of any party.

Previous Date: October 1990
Reissued Date:

TO: Regional Water Engineers, Bureau Directors, Section Chiefs

SUBJECT: Division of Water Technical and Operational Guidance Series (1.3.1.D)

TOTAL MAXIMUM DAILY LOADS AND WATER QUALITY-BASED EFFLUENT LIMITS

AMENDMENT - WASTE ASSIMILATION CAPACITY DETERMINATIONS FOR ISOLATED WASTEWATER DISCHARGES IN FRESH WATER STREAMS

(Originator: Albert W. Bromberg/Charles St. Lucia)

I. PURPOSE

The purpose of this guidance is to provide procedures and methodologies for determining waste assimilation capacities and allowable waste loadings from isolated wastewater discharges to fresh water streams. Such discharges are not necessarily geographically isolated; rather they do not have a cumulative interacting effect on the receiving stream with other wasteloads and consequently can be evaluated as individual "isolated" discharges. It provides guidance for stream reaction kinetics, design parameters, waterbody characteristics, and applicable stream standards related to oxygen demanding discharges to water quality limiting stream segments.

II. **DISCUSSION**

TOGS 1.3.1 defines the criteria applicable to waste assimilative capacity analysis and allocation in order to determine allowable effluent limits for wastewater discharges to water quality limiting stream segments. Factors are presented for consideration in developing mathematical water quality (dissolved oxygen) models. In most cases, such models are calibrated and verified using physical and chemical stream survey data. However, in some cases where a small isolated discharge to a uniform stream segment is to be considered and field data are unavailable, allowable effluent limits may be determined by applying a conservative, "desktop" analysis based upon the physical characteristics of the receiving stream. The following guidelines should be used for such simplified analyses.

III. **GUIDANCE**

A. Receiving Stream Considerations

1. Determine receiving stream name, waters index number, and current official classification from the Official Compilation of Codes, Rules and Regulations of the State of New York, Title 6 - Conservation, Volumes B,C,D,E,F.

2. Determine the statistical minimum average seven consecutive day streamflow occurring once in ten years (MA7CD/10). This value may be obtained from the U.S. Geological Survey, Albany, New York, or the NYS Department of Environmental Conservation, Bureau of Monitoring and Assessment, 50 Wolf Road, Albany, New York 12233-3503 or by extrapolation from Low Flow Frequency Analyses of Streams in New York, Bulletin 74, USGS/NYSDEC, 1979.

3. Discharges to Intermittent Streams

   An intermittent stream is defined as a stream which periodically goes dry or whose MA7CD/10 flow is less than 0.1 cfs as estimated by methods other than continuous daily flow measurements.

   The current guidance relating to discharges to intermittent streams is outlined in Division of Water Technical and Operational Guidance Series (1.3.1.B) - "Waste Assimilative Capacity Analysis for Discharges to Low and Intermittent Flow Streams".

4. Stream Standards

   a) General:

      Refer to "Water Quality Regulations" New York State Codes, Rules and Regulations Title 6, Chapter X, Parts 700-705 (Revised September 1, 1991) and TOGS 1.1.1.

   b) Dissolved Oxygen:

For purposes of performing waste assimilative capacity analyses using the conservative parameters presented in this

paper, the "minimum at anytime" dissolved oxygen standard should be used as per Part 703.3.

c) Ammonia or ammonium compounds:

Refer to Division of Water Technical and Operational Guidance Series (1.1.1), "Ambient Water Quality Standards and Guidance Values". The table for total ammonia standards from the 10/22/93 document is attached.

B. Receiving Waters Design Parameters

1. If there are no upstream discharges, and no oxygen data available, assume D.O. to be at 90% saturation (see Table I following).

2. Unless temperature data for summer drought flow periods is available, use the following stream temperatures:

   a) Non-trout stream . . . . 25°C
   b) Trout Stream . . . . 24°C

TABLE I
Dissolved Oxygen Saturation Values (mg/1)

Elevation - Feet	"B" (MM)*	100% Sat. 25°C	100% Sat. 24°C	90% Sat. 25°C	90% Sat. 24°C
0	760	8.3	8.4	7.5	7.6
500	746	8.1	8.3	7.3	7.5
1000	732	8.0	8.1	7.2	7.3
1500	718	7.8	8.0	7.0	7.2
2000	704	7.7	7.8	6.9	7.0
2500	690	7.5	7.7	6.7	6.9
3000	677	7.4	7.5	6.7	6.7

*"B" is barometric pressure

3. If there are no upstream discharges and no quality data are available, assume upstream TOD = 3.0 mg/l. (TOD = $CBOD_u$ + NOD. The subscript "u" denotes ultimate BOD.)

4. Stream self purification factor "f": See Table II

5. K_1 (bottle rate), base "e": Use 0.23/day unless specific data are available.

6. K_1 (base 10) = K_1 (base e) /2.3

7. $K_n = K_1$ unless otherwise determined from available data.

8. $K_2 = f \times K_1$

TABLE II
Typical Values of "f"

Nature of Receiving Waters	"f" Values
Small ponds and backwaters	0.5 - 1.0
Sluggish streams, large lakes or impoundments	1.0 - 1.5
Large streams of slow velocity	1.5 - 2.0
Large streams of moderate velocity	2.0 - 3.0
Swift streams	3.0 - 5.0
Rapids, waterfalls, etc.	5.0 and up

If selection of the "f" factor is critical to the degree of treatment required, the more conservative value should be used unless a higher value can be justified by some other means (i.e. sampling data).

C. Wastewater Characteristics

1. $CBOD_u$ (Carbonaceous oxygen demand)

Where no $CBOD_u$ data are available, the largest of the following should be used:

a) $CBOD_u$ (lbs/day) = 1.5 x BOD_5 for domestic wastes (normally 1.5 x 200 mg/l = 300 mg/l) x 8.34 x MGD

b) $CBOD_u \text{ (lbs/day)} = \dfrac{BOD_5 \times 8.34 \times MGD}{(1-e^{-K\,t})}$ for other wastes
where t=5 days, K_1 = deoxygenation rate of waste (base "e")

c) $CBOD_u$ (lbs/day) = Population x Population Equivalent (P.E.).
P.E. = 0.25 lb/day $CBOD_u$

2. NOD (Nitrogenous oxygen demand)

The nitrogenous compounds NH_3 and Organic N exert an oxygen demand when they are oxidized by nitrifying bacteria to form nitrates. NH_3 and Organic N concentrations of raw domestic sewage are typically around 25 mg/l and 15 mg/l respectively. One mg/l of NH_3 or organic N requires 4.57 mg/l of oxygen to be completely oxidized to nitrates.

The ultimate nitrogenous oxygen demand is determined by using the largest of the following:

a) NOD = (25 mg/l + 15 mg/l) x 4.5 = 180 mg/l for raw, domestic sewage. NOD (lb/day) = 180 mg/l x 8.34 x MGD.

b) NOD (lb/day) = 0.15 lb/day x Population
Some industrial wastes also contain NH_3 and Organic Nitrogen. The concentrations should be determined from waste sampling. The

nitrogenous oxygen demand would then be determined as shown above.

3. TOD (Total Ultimate Oxygen Demand)

The total ultimate oxygen demand (TOD) is the sum of items 1 and 2 ($CBOD_u$ and NOD). The typical TOD of raw domestic sewage would therefore be 300 mg/l + 180 mg/l, or 480 mg/l converted into lb/day, or the largest total of the above $CBOD_u$ and NOD values. TOD is often used synonymously with UOD (Ultimate Oxygen Demand).

Unless waste flow, Q_w, is known, use 100 gpcd (gallons per capita per day).

4. Effluent Dissolved Oxygen

The effluent dissolved oxygen content is normally assumed to be as follows; however, it may be higher or lower depending upon the treatment processes used and the outfall configuration. Also in cases where a high degree of effluent polishing is required, it may prove desirable (or necessary) to provide effluent aeration devices.

Trickling filter effluents . . . . 4.0 mg/l
Activated sludge process effluents . . . . 2.0 mg/l

5. Disinfection

Adequate disinfection of wastewater effluents is required to meet water quality standards for streams classified AA, A, SA, GA, B & SB (seasonal option) and may be required for lower classifications where a public health need exists. The period of disinfection for discharges to Class B and SB waters and the need and period applicable to other lower class streams is the responsibility of the DEC Regional Office in concert with the Health Department office having jurisdiction. The New York State Health Department is charged with the responsibility of determining disinfection needs for purposes of protection of public health.

D. Computation of Waste Assimilation Capacity and Waste Treatment Requirements

1. Compute the initial dissolved oxygen deficit D_a:

$$D_a = \frac{(Q_w \times D_w) + (Q_s \times D_s)}{Q_w + Q_s}$$

Where: Q_w = waste flow
D_w = Waste Deficit = C_s - D.O. waste
(C_s = Saturation concentration; see Table I)
Q_s = Streamflow, MGD
D_s = Stream deficit = C_s - D.O. stream (usually 10% of C_s if there is no upstream pollution, see item B-1)

2. Determine the "f" factor to be used from Table II.

3. Compute the critical deficit D_c by subtracting the minimum allowable stream standard D.O. concentration from C_s, the saturation concentration. That is, $D_c = C_s$ - Stream Standard.

4. Go to figures 1-7, knowing D_c, D_a, and "f", and find L_a which is the maximum allowable stream concentration of ultimate oxygen demand.

5. Compute the waste assimilation capacity from the following relationship:

   Waste assimilation capacity, TOD in lbs/day =

   $$[(Q_w + Q_s) \times L_a \times 8.34] - [Q_s \times 3.0 \times 8.34]$$

   Where: Q_w = waste flow in MGD
   Q_s = stream flow in MGD
   L_a = mg/l of total oxygen demand

   The above assumes a relatively uncontaminated upstream TOD of 3.0 mg/l. If the upstream TOD is known to be higher or lower, the actual TOD value should be substituted for the value 3.0 in the expression: $[Q_s \times 3.0 \times 8.34]$.

6. If the receiving stream is a regulated stream (controlled flow), 30 percent of the waste assimilation capacity (WAC) should be held in reserve for safety factors or reliability factors.

   Therefore, the net "WAC" = 0.70 times item 5 above. As an alternate to this step, use 0.70 x minimum release (Q_s) to provide an assimilative capacity reserve.

7. Compute the proposed effluent loading: TOD (lbs/day) = $[(1.0-E_b) \times CBOD_u + (1.0-E_n) \times NOD] \times Q_w \times 8.34$.

   E_b = BPT treatment efficiency with regard to carbonaceous BOD removal, usually 85% for municipal type discharges as defined by DEC's Bureau of Wastewater Facilities Design.

   $CBOD_u$ = Raw CBOD ultimate, mg/l

   E_n = Treatment efficiency with regard to nitrogenous oxygen demand, may be 50% for secondary treatment discharges during critical warm weather conditions. Stream NOD capacity and wasteload allocation may require a higher efficiency.

   NOD = raw nitrogenous oxygen demand, mg/l

   Q_w = waste flow, MGD

8. Compare item 7 with item 5 or 6 above. If item 7 is greater than item 5 or 6, more treatment is required. Check item 9 below.

9. Also, the NH_3 standard should be met taking into account any upstream NH_3 concentration which may exist. If no site-specific data are available, assume the background NH_3 concentration to be 0.1 mg/l.

a) The allowable NH_3 discharge to the stream (in lbs/day) = (Q_s + Q_w) x (NH_3 standard in mg/l) x 8.34 where Q_w and Q_s are in MGD.

b) The amount of NH_3 in the effluent = (1-E_n) x 25 x Q_w x 8.34 again where Q_w is in MGD.

If 9b is greater than 9a, more NH_3 needs to be removed in the treatment plant even though the NOD requirement may be complied with.

____

N.G. Kaul, Director
Division of Water