Petroleum Refining Industry Contribution to Nationwide Surface Water Nutrient Loadings

API PUBLICATION 4782
AUGUST 2016

AMERICAN PETROLEUM INSTITUTE

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Executive Summary

This analysis was commissioned by API to provide member companies and the public with a better understanding of the water quality problems associated with nutrient discharges to the nation's surface waters, the current federal and state regulatory responses to nutrient-related water quality problems, the scientific and implementation challenges of nutrient controls, and the petroleum refining industry's relative contribution to nationwide nutrient discharges to surface waters.

The overwhelming majority of total nitrogen (TN) and total phosphorus (TP) nutrient loadings to surface waters is from nonpoint sources. A significant contribution also comes from municipal wastewater effluents. Petroleum refineries contribute only 0.1 % of the nationwide TN loading and only 0.08 % of the nationwide TP loading to surface waters. Clearly, nutrient control efforts targeting the petroleum industry, though perhaps important in specific circumstances, will not resolve the majority of nutrient impairments of our nation's waters; control efforts must focus on reductions in nonpoint source and municipal nutrient loadings if meaningful gains in water quality are to be achieved.

The key findings of this study are as follows:

- The two so-called macronutrients, TN and TP, are almost always the growth-limiting nutrients for aquatic plant growth and are the focus of regulatory agency efforts to control such growth to protect water quality.

- The quantities of TN and TP that cause aquatic plant growth sufficient to impair water quality and designated uses are inherently water body specific. The physical and chemical characteristics of each water body are important determinants of the type of aquatic plants, their growth rates, and the total density of such growth, which in turn determine impairment of water quality and/or designated uses of the water body.

- The enrichment of surface waters with the plant nutrients TN and TP causes impairments of water quality and failure to attain designated water uses in a large number of surface water bodies in the United States, including rivers and streams, lakes and reservoirs, estuaries, and coastal waters.

- The inherent water body–specific characteristics of nutrient enrichment have made it difficult for states to establish scientifically sound water quality standards for nutrients. Because of this difficulty, many states rely on narrative water quality standards to address nutrient enrichment.

- The U.S. Environmental Protection Agency (EPA) has been encouraging states to adopt numeric standards for TN and TP for the past 20 years. The water body–specific characteristics of nutrient enrichment have made a "one-size-fits-all" approach to numeric nutrient standards impossible, so most states have been slow to adopt numeric nutrient standards.

- EPA's most recent initiative is for states to adopt "independently applicable" numeric standards for both TN and TP, regardless of which one is the limiting nutrient in a specific surface water body. Many states have rejected this approach as not scientifically justified.

- There are many sources of TN and TP that discharge to surface waters. These can be both natural and anthropogenic. However, the research shows that anthropogenic sources are the principal cause of excessive nutrient concentrations in surface waters. Nonpoint sources such as agriculture, fertilizer application in urban and suburban areas, urban runoff, and atmospheric deposition are typically cited as the source of 90 % or more of the excess nutrients discharged to surface waters of the United States.

  This study of nutrient loading sources using data compiled from EPA databases, the scientific literature, technical textbooks, and several states has shown that on a nationwide basis (Figure ES-1):

- 84.6 % of the TP loading and 84.1 % of the TN loading on surface waters are due to nonpoint sources.
- Municipal wastewater effluents (publicly owned treatment works [POTWs]) account for 14.1 % of the TP loading and 14.6 % of the TN loading.
- The total industrial point source loadings of TP and TN are estimated at 1.3 % of the national totals.
- Petroleum refineries contribute 0.08 % and 0.1 % of the nationwide TP and TN loadings on surface waters, respectively.

- These relative loadings demonstrate that nutrient control efforts must focus on reductions in nonpoint source nutrient loadings if there are to be any meaningful results in reducing nutrient enrichment of the nation's surface waters.
- This analysis does not conclude that point source nutrient contributions are insignificant in all water bodies, and it is not intended to justify inaction in such instances. Rather, each water body must be evaluated by considering its physical, chemical, and biological characteristics; the point and nonpoint sources that contribute nutrients; and the effects of such nutrients on aquatic plant growth before establishing limitations on TN and TP for point source discharges.

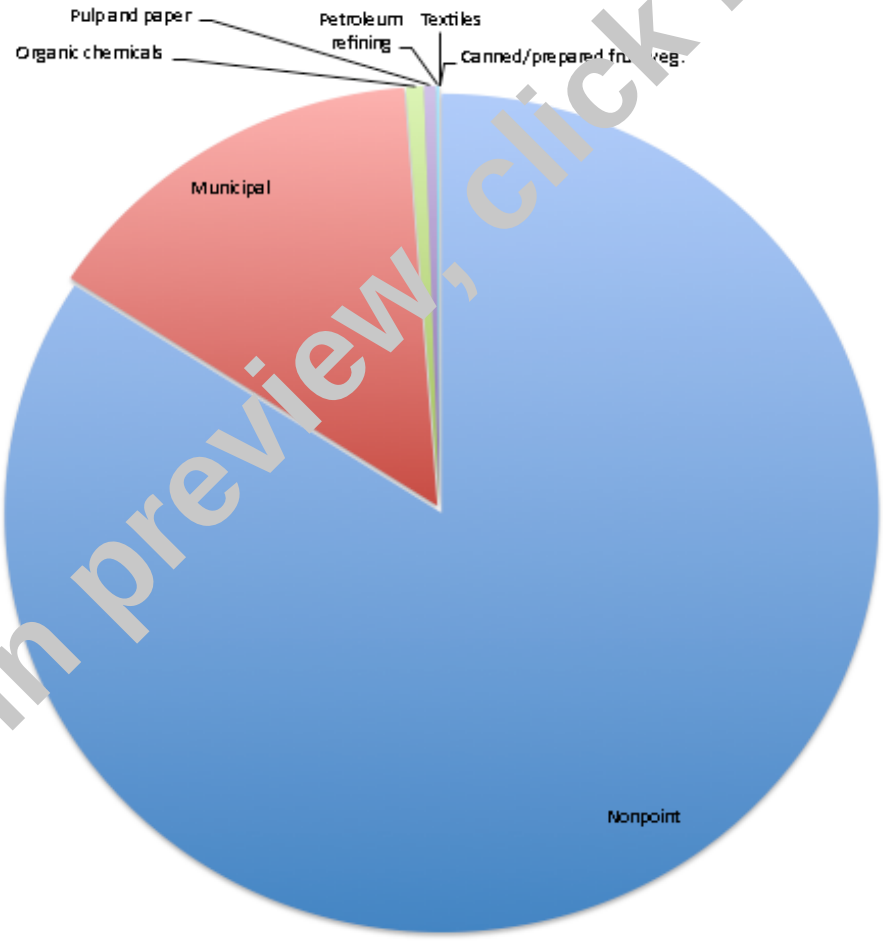

Figure ES-1—Percent Contributions to Total National Nutrient Loadings

Abbreviations

BMP	Best Management Practice
CWA	Clean Water Act
DMR	Discharge Monitoring Report
ELG	Effluent Limitation Guideline
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
NEIWPCC	New England Interstate Water Pollution Control Commission
NPDES	National Pollutant Discharge Elimination System
PCS	Permit Compliance System
POTW	Publicly Owned Treatment Works
SAB	Science Advisory Board
TBEL	Technology-based Effluent Limit
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TPDES	Texas Pollutant Discharge Elimination System
TRI	Toxics Release Inventory
WQBEL	Water Quality–based Effluent Limit

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Chapter 1—Introduction

The U.S. Environmental Protection Agency (EPA) and many states have agreed that loadings of nutrients to surface waters are generally increasing and excess nitrogen and phosphorus levels are contributing to degradation of surface water quality in certain water bodies (EPA, 2009a). EPA and the states have been working for decades on approaches to controlling nutrients, and it is probable that more stringent water quality–based effluent limits (WQBELs) for nitrogen and phosphorus could be imposed on point source dischargers in future years. This report provides an overview of the national issue of nutrient enrichment of surface waters, the sources of such nutrients, and the significance of petroleum refining industry discharge contributions to nationwide nutrient loadings.

Scope

This study is based on using available published data on nutrient enrichment of U.S. surface waters; EPA and state nutrient control guidance, policy, and water quality standards; prior analysis performed for API by a third-party consultant; petroleum refinery effluent quality data from the EPA Integrated Compliance Information System/National Pollutant Discharge Elimination System (ICIS-NPDES); and permit data collected from the files of the Texas Commission on Environmental Quality (TCEQ).

Organization

Chapter 2 presents a description of nutrients and their effects on water quality and receiving water uses. The terminology describing nutrient enrichment in surface waters is presented, and the fundamental interactions among nutrients, aquatic biology, and other water quality constituents are summarized to provide a basic understanding of the issues and complexities involved in evaluating the effects of nutrients on water quality.

Chapter 3 presents the evaluation of the petroleum refining industry's contribution of nitrogen and phosphorus, the primary nutrients of concern, to surface waters of the United States. The petroleum refinery contributions are compared with the contributions from other point and nonpoint sources of these constituents, including discharges from publicly owned treatment works (POTWs), agricultural sources, and urban runoff. A ranking of nutrient contributions from the petroleum refining industry relative to the other point and nonpoint source categories is based on the combined data available for nitrogen and phosphorus.

Chapter 4 provides an overview of the history of and recent developments in nutrient control policy and regulation. A summary of nutrient enrichment impacts of major point source categories and nonpoint sources on both national and regional scales is presented. The chapter also summarizes surface water body impairments and major nutrient total maximum daily load (TMDL) studies at the national level.

Chapter 5 presents a summary of the principal findings in the report and the conclusions of this evaluation.

Principal Finding

The overwhelming majority of total nitrogen (TN) and total phosphorus (TP) nutrient loadings to surface waters is from nonpoint sources. A significant contribution also comes from municipal wastewater effluents. Petroleum refineries contribute only 0.1 % of the nationwide TN loading and only 0.08 % of the nationwide TP loading to surface waters. Clearly, nutrient control efforts targeting the petroleum industry, though perhaps important in specific circumstances, will not resolve the majority of nutrient impairments of our nation's waters; control efforts must focus on reductions in nonpoint source and municipal nutrient loadings if meaningful gains in water quality are to be achieved.