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Selection of Business Types for the Installation of Nonpoint Pollution Source Control Facilities

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Abstract

In 2004, the Korean government launched comprehensive measures for nonpoint pollution that were intended to reduce their amount by 34.3% over of those forecast by 2020. During the first and second stages of their implementation; from 2004 to 2011, nonpoint source (NPS) measures have focused on systemic improvements and project management, as well as the introduction of optimal management techniques; accordingly, reductions have been small. However, during the third stage in 2011, serious reductions will be pursued. Accordingly, the gradual expansion of sites subject to NPS measures has focused on the establishment of a basis for reduction measures in connection with model projects during the first half of the plan, with full scale enforcement due in the second half. For Korea, rather than commencing NPS management en masse, it has been more appropriate to gradate NPS management into stages tailored to the different needs of new and existing businesses, as well as to the needs of large and small-scale businesses, in consideration of their specific circumstances. This has allowed sufficient time for such businesses to become accustomed to the concept of NPS management.

Keywords : Control facilities, Industries, Nonpoint pollution

1. Introduction

In March, 2004, the "Comprehensive Measures on Nonpoint Pollution Source Management for the 4 Major Rivers" were established by the relevant authorities to enhance the "Comprehensive Measures on Water Quality Management" and to develop governmental measures on nonpoint sources (NPS) by 2020[1]. However, the results have been limited due to inadequate legal and institutional systems for NPS management; particularly, the lack of any means to manage businesses and construction sites that discharge runoff where the pollution levels exceed permissible water quality standards. Because NPS management is most efficient when managed at its source, the active participation of all stakeholders is required, including the authorities, private developers, and manufacturers.

Therefore, a reporting system for the installation of NPS facilities and for business and construction sites (begun in March 2006) was introduced to prepare the legal grounds for promoting the government policy. The reporting and installation system for NPS management requires construction sites already subject to environmental assessments, as well as businesses that can potentially discharge wastewater from NPS, to install control facilities. Accordingly, this study was intended to suggest the industries that should be subject to NPS management measures pursuant to changes in the law, as well as the appropriate scope and extent of such management.

Up to the present, pollutant sources have been categorized as "wastewater discharging facilities" (accounting for 82 industries typed by process, including "coal" and "mining") and as "other water quality pollutant sources" (accounting for five industries, including "aquaculture facilities" and "golf courses")[2]. Nonpoint sources discharged with rainwater have not been adequately addressed. Fortunately, since March 2006, nonpoint pollutant discharging facilities have been compelled to report on their NPS management, and to install appropriate control systems. Accordingly, this study was enacted to discern what types of facilities should be subject to management measures due to excessive discharges of nonpoint pollutants.

2. Selection of Industries Subject to NPS Management

A number of recent domestic and foreign studies have found a large number of cases where concentrations of pollutants in runoff discharged from raw materials stored outdoors, as well as from waste materials left on the roadside, exceeded limits set for wastewater discharging facilities; thus, constituting major release points for hazardous materials[2-4]. Accordingly, research is needed on what kind of NPS facilities should be subject to

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Table 1. Industrial classification

Main category	Industry (subcategory)	Industry (abridged)
Mining etc. (3)	Coal, oil and uranium mining	Coal, oil and uranium mining
	Metal mining	Metal mining
	Non-metal mining	Non-metal mining
Manufacturing (23)	Food & beverages	Food
	Tobacco products	Tobacco
	Textile products (excluding apparel)	Textiles
	Apparel and fur products	Apparel
	Leather, bags, and shoes	Leather
	Wood and wood products	Wood
	Pulp, paper, and paper products	Paper
	Publication, printing, and recorded media	Printing
	Coke, petrochemicals, and nuclear fuel	Petroleum
	Chemicals and chemical products	Chemicals
	Rubber and plastic products	Plastic
	Non-metal mineral products	Non-metals
	Primary metals	Primary metals
	Assembled metal products	Assembled metals
	Other machinery and equipment	Machinery and equipment
	Computer and office appliances	Computers
	Other electrical machinery	Electrical machinery
	Electronic components; radio, television, and communications equipment	Television & communications
	Medical, precision, and optical instruments; watches & clocks	Medical optics
	Motor vehicles & trailers	Motor vehicles
	Other transport equipment	Other transport
	Furniture and other products	Furniture etc.
	Compounded materials for recycling	Recycled materials

Table 2. Designation of industries subject to regulation

Domestic industry (subcategory)	Grounds
Wood and paper	Use of hazardous substances, processing near roads, exposure of products to rainfall
Chemicals, rubber, and plastics	Use of various chemicals, petroleum related pollutants, exposure of manufacturing equipment to rainfall
Refined petroleum products	Exposure of manufacturing equipment to rainfall, petroleum related pollutants
Primary metals	Exposure of manufacturing processes, outdoor storage of raw materials, civil petitions arising from substantial leaks of SS
Nonmetal mineral products	Exposure of processes and products, atmospheric loading from scattering dust, SS leakage
Textiles/dyeing	Use of various chemicals, various dyes
Environmental treatment, including environmental recycling	Oils, exposure to related pollutants, processes exposed to rainfall

increased regulation, as well as what levels of pollution constitute grounds for such regulation.

Industries that discharge significant amounts of nonpoint pollution include wood, paper, chemicals, petroleum, coal, metal, leather, stone, clay and glass manufacturing, as well as mining, hazardous waste, landfill, recycling, thermal power, transportation and environmental treatment[2].

As NPS management is still in its infancy, it is desirable at the outset to minimize the scope of industries subject to NPS management measures. Accordingly, it is appropriate that business sites subject to the management targets are those newly established in industries deemed problematic (e.g. steel, textile dyes) and operating over a prescribed scale. In order to select the industries and applicable size of businesses subject to NPS measures, this study used industrial classifications based on the Comprehensive Survey on Industry. These industries are shown in Table 1[5].

Among the industries in Table 1, major NPS dischargers include primary metals, petroleum, chemicals, rubber, plastic, wood, paper, nonmetals, textiles and waste treatment/disposal

Table 3. Main pollutants generated by each industry

Industry	Type of discharge	Pollutants
Primary metals	- All runoff from industrial activities	Oil/grease, COD, TSS, pH, highly hazardous materials, lead, cadmium, copper, arsenic, chromium
Refined petroleum products	- Runoff from oil processing facilities	Oil/grease, COD, TSS, pH, pollutants specific to the industry in question
Chemicals, rubber, and plastics	- Runoff from direct contact with solid chemical storage	Oil/grease, COD, TSS, pH, BOD_5, TKN, T-P, substances hazardous to water quality, pollutants specific to the industry in question
Wood and paper	- Runoff from storage and processing sites for surface treated and finished wood - Runoff containing miscellaneous hazardous materials used in wood processing	Oil/grease, pH, COD, TSS, acutely hazardous materials
Nonmetal mineral products	- All runoff from industrial activities	Oil/grease, COD, TSS, pH, pollutants specific to the industry in question
Fabrics / dyeing	- All runoff from industrial activities	COD, TSS, pH, pollutants specific to the industry in question
Waste treatment	- Leakage of fluid and dust from various waste products, runoff	Oil/grease, COD, TSS, pH, pollutants specific to the industry in question

COD: Chemical Oxygen Demand, TSS: Total Suspended Solids, BOD_5: Biological Oxygen Demand of 5days, TKN: Total Kjeldahl Nitrogen, T-P: Total Phosphorus.

Table 4. Wastewater discharge amounts by land area

Class	Wastewater discharge (tons/day)	Site area for the first 5 mm of runoff (m^2)
Class 1	2,000	400,000
Class 2	700-2,000	140,000-400,000
Class 3	200-700	40,000-140,000
Class 4	50-200	10,000-40,000

industries (Table 2). The main pollutants generated by the industries are shown in Table 3. Accordingly, it is appropriate that new business sites in the foregoing industries found to be discharging excessive nonpoint pollutants provide reports on how these will be managed, and for existing businesses to establish and execute voluntary NPS management plans. NPS management requirements will be expanded to all such businesses over the long term.

3. Estimation of Management Scale for the Application of NPS Measures

As per the aforementioned, it was decided that the scope of industries subject to regulation would be expanded gradually, and that as an initial stage of this process, facilities over a certain size and scale wishing to install new plants would be compelled to install runoff control facilities. In order to expand measures to existing facilities over the long term, new and existing businesses were reviewed simultaneously. To this end, the number of companies subject to NPS measures was determined according to the area of their work sites. The most recent Comprehensive Survey on Industries was published in 2003, and divided the economy into two main categories, "mining" and "manufacturing," and thereafter into categories, subcategories, sub-sub categories, and micro-categories. In this study, a land area analysis was conducted on 23 categories, i.e. industries, in manufacturing (excluding mining), where the land area was not indicated.

The land areas for the sites in 23 industries were classified by size; from 1) less than 10,000 m^2, 2) 10,000-40,000 m^2, 3) 40,000-140,000 m^2, 4) 140,000-400,000 m^2, and 5) over 400,000 m^2. The numbers and shares of businesses corresponding to the above areas were also analyzed. The aforementioned land areas were then compared against four classes devised in accordance with the runoff released during the first 5 mm of rainfall. In Class 4; for example, 50 tons of runoff are generated during the initial 5 mm of rainfall on a site with an area of 10,000 m^2. The amount of wastewater discharged by land area is shown in Table 4.

3.1. Determination of the Number of Eligible Businesses

An analysis of newly established business sites was performed in 2003. At present, there has been no aggregate survey on the site area of work sites other than data maintained by the National Statistical Office[5]. Moreover, the data retained by the National Statistical Office, with respect to the date of establishment, has

Table 5. Number of businesses by land area and industry

Site area (m²)	Less than 10,000		10,000-40,000		40,000-140,000		140,000-400,000		More than 400,000	
Industrial classification	No. of businesses	Share (%)	No. of businesses	Share (%)	No. of businesses	Share (%)	No. of businesses	Share (%)	No. of businesses	Share (%)
Food	1,522	96.82	42	2.67	8	0.51	0	0.00	0	0.00
Tobacco	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
Textiles	1,561	98.86	16	1.01	2	0.13	0	0.00	0	0.00
Apparel	1,869	99.79	3	0.16	1	0.05	0	0.00	0	0.00
Leather	444	99.33	2	0.45	1	0.22	0	0.00	0	0.00
Wood	376	98.69	5	1.31	0	0.00	0	0.00	0	0.00
Paper	468	98.11	8	1.68	1	0.21	0	0.00	0	0.00
Printing	1,214	99.92	0	0.00	1	0.08	0	0.00	0	0.00
Petroleum	12	85.71	2	4.29	0	0.00	0	0.00	0	0.00
Chemicals	567	95.45	23	3.87	3	0.51	1	0.17	0	0.00
Plastics	1,759	98.10	32	1.78	2	0.11	0	0.00	0	0.00
Nonmetals	603	89.33	62	9.19	8	1.19	2	0.30	0	0.00
Primary metals	297	90.83	25	7.65	5	1.53	0	0.00	0	0.00
Assembled metals	3,093	98.10	58	1.84	2	0.06	0	0.00	0	0.00
Machinery & equipment	2,866	99.20	18	0.62	3	0.10	2	0.07	0	0.00
Computers	166	98.22	3	1.78	0	0.00	0	0.00	0	0.00
Electronic machinery	1,110	98.84	12	1.07	0	0.00	1	0.09	0	0.00
Television & communications	1,076	98.26	17	1.55	0	0.00	1	0.09	1	0.09
Medical/optical	550	98.57	8	1.43	0	0.00	0	0.00	0	0.00
Motor vehicles	583	95.57	25	4.10	2	0.33	0	0.00	0	0.00
Other transport	180	94.74	8	4.21	1	0.53	1	0.53	0	0.00
Furniture etc.	1,465	99.59	6	0.41	0	0.00	0	0.00	0	0.00
Recycled materials	92	90.20	9	8.82	1	0.98	0	0.00	0	0.00
Total	21,873	98.05	384	1.72	41	0.18	9	0.04	1	0.00

not undergone internal review, indicating a low level of reliability. Accordingly, other methods were deployed that used identification numbers for each business. Identification numbers for 2002 and 2003, the most recent years for which data were available, were collected from the National Statistical Office, with businesses started in 2003 further categorized. A total of 21,873 businesses were deemed suitable for the analysis (Table 5).

3.2. Determination of Management Scale

Newly established work sites categorized as excessive nonpoint

Table 6. Work sites subject to NPS management measures and relevant measures

Major NPSs	Domestic sites and applicable measures	
	Target	Management method
Large scale work sites	- Work sites over 10,000 m² in area, including those for textiles, wood, paper, petroleum, chemicals, plastics, and primary metal products	- Reporting and installation of NPS control facilities has been made compulsory
	- Work sites over 40,000 m² in area, excluding the foregoing types	- NPS management plans are to be prepared, and management is to occur on a voluntary basis
Small scale work sites	- New work sites over 10,000 m² in area, including those for textiles, wood, paper, petroleum, chemicals, plastics, and primary metal products	- NPS management plans are to be prepared, and management is to occur on a voluntary basis
	- Work sites over 10,000 m² in area, excluding the foregoing types	- Local governments are to provide guidance with respect to NPS mitigation schemes, with management thereof on a voluntary basis

NPS: nonpoint source.

pollutant dischargers will be compelled to submit a report on NPS management and install appropriate mitigation facilities. Businesses that exceed the allowed amount of runoff discharges for Class 4 were designated as being subject to NPS management measures. Although such measures currently apply to newly and recently established work sites, such measures will also be expanded to pre-existing work sites over the long term.

Furthermore, as NPS are generated during rainfall, sites subject to NPS measures should not be restricted to the pollutant discharging facilities, but should target the entirety of the work site, as runoff is generated throughout the entire area whenever rain falls. For example, for a 10,000 m^2 site, 50 tons of runoff is generated, corresponding to Class 4 wastewater discharge, in the first 5mm of rainfall. The number of industries falling under this category is delineated in Table 5.

Business sites in all classes having a land area over 10,000 m^2, with wastewater discharging facilities installed, are compelled to prepare an NPS management plan and to voluntarily manage and install NPS management facilities.

4. Conclusions

In 2004, the Korean government launched comprehensive measures for nonpoint pollution, which were intended to reduce their amount by 34.3% over of those forecast by 2020. During the first and second stages, from 2004 to 2011, NPS mitigation measures have focused on systemic improvements and project management, as well as the introduction of optimal management techniques; accordingly, reductions have been small. However, during the third stage in 2011, serious reductions will be pursued. Accordingly, the gradual expansion of sites subject to NPS measures has focused on the establishment of a basis for reduction measures in connection with model projects during the first half of the plan, with full scale enforcement due in the second half. Legal and institutional improvements should be prepared, with government support, in the first half of the plan, with an emphasis on voluntary achievement of targets rather than compulsory enforcement. After 2011, when the institutions are in place, legal grounds should be created to induce full reduction through the active installation of reduction facilities.

As nonpoint pollutants are discharged regardless of the presence of wastewater discharging facilities, it is desirable to expand enforcement to all industries over the long-term. Major nonpoint dischargers include hazardous waste landfills, transport related facilities (cargo terminals, passenger terminals, etc), recycling facilities and environmental treatment facilities. While most of these facilities have relatively low amounts of wastewater discharges, they can be significant sources of nonpoint pollution if not properly managed. Industrial and manufacturing facilities, outdoor storage areas and waste storage facilities exposed to rainfall are particular problems. For Korea, rather than commencing NPS management en masse, it has been more appropriate to gradate NPS management into stages tailored to the different needs of new and existing businesses, as well as to the needs of large and small scale businesses in consideration of their specific circumstances. This has allowed sufficient time for such businesses to become accustomed to the concept of NPS management.

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References

1. Comprehensive measures on nonpoint source management for the 4 major rivers. Gwacheon, Korea: Ministry of Environment; 2004 (in Korean).

2. Guidelines for nonpoint source management. Gwacheon, Korea: Ministry of Environment; 2005 (in Korean).

3. Region 10, the Pacific northwest. Runoff permitting information for industrial activities. Washington, DC: U.S. Environmental Protection Agency; 2005.

4. The Mid-Atlantic States. Storwmwater pollution prevention. Washington, DC: U.S. Environmental Protection Agency; 2005.

5. Comprehensive survey on industry. Seoul, Korea: National Statistical Office; 2004 (in Korean).