

# **Chapter I**

## **Environmental Impact Assessment in Air Quality, Water Quality, Soil Quality and Environmental Load**

### **1. Air Quality, water quality and soil quality**

#### **1.1 Air quality**

The major environmental components in the Category of air quality under the Environmental Impact Assessment Act are ambient air quality, offensive odors, noise and infrasound, and vibration.

##### **1.1.1 Characteristics of air quality**

Sources of air pollutants can be broadly classified into fixed sources including factories, workshops, and ventilation towers, and mobile sources such as motor vehicles, aircraft, and ships. As air pollutants are carried and spread by the air itself, the effect they have on air quality is greatly influenced by the type of generating source, conditions in the areas where the air pollutants are carried and spread, and air movement (wind direction and velocity), and depending on conditions, these pollutants can extend over quite a large area. The impact on humans will vary according to the pollutants, but is broadly classified into acute effect and chronic effect, and there is a need to examine the impact from both perspectives.

In addition to nitrogen oxide and suspended particulate matter, environmental impact assessments on air quality may also detect problems of dioxin, benzene, mercury and other hazardous substances. There are also occasions when not just annual average concentrations, which have been the traditional focus of environmental impact assessments, but short-term concentrations arising under special meteorological conditions including downwash and fumigation become quite significant. Expertise on measures and methods to tackle and forecast sources of nitrogen oxides, suspended particulate matter and other regulated air pollutants have been built up over many years, and depending on local conditions and the required accuracy, there is a need to consider both advanced and simple methods, and choose the most appropriate.

Japan's air quality has generally been improving in recent years, and environmental standards for sulfur dioxide, carbon monoxide, nitrogen dioxide, and suspended particulate matter have been met at almost 100% of general air pollution monitoring stations and automobile exhaust gas monitoring stations. In contrast, although progress is being made in measures to restrict emissions of nitrogen oxide and volatile organic compounds (substances that cause photochemical oxidants), and the reduction in the high concentrations of pollution that exceed the levels requiring the issue of warnings indicate that improvements are being achieved, environmental standards are only being met at less than 1% of the monitoring stations.

Regarding mercury, the Air Pollution Control Act (Act No. 97 of June 10, 1968) was amended in June 2015 to facilitate the precise and smooth implementation of the Minamata

Convention on Mercury (signed on October 10, 2013), and obligated persons that emit mercury from mercury emission facilities to comply with emission standards.

Annual average concentrations of fine particulate matter, whose environmental standards were set in 2009, have generally followed a downward trend, although this has tended to level off in recent years, and the rate at which these standards are being met is quite a low 16% (general air pollution monitoring stations; fiscal 2013).

In this light, there are calls for environmental impact assessments for photochemical oxidants and fine particulate matter considering the low rates at which environmental standards are being achieved. However, the formation of photochemical oxidants are substantially affected by the amount of solar radiation, air temperature, atmospheric stability and other meteorological conditions in addition to the atmospheric concentration of the causative substances of nitrogen oxides and volatile organic compounds, while fine particulate matter consists not just of particles emitted directly from the source into the atmosphere following combustion (primary generated particles) but also particles that have formed after gaseous air pollutants (sulfur oxides, nitrogen oxides, volatile organic compounds, etc.) undergo a chemical reaction in the atmosphere (secondary generated particles), so forecasting these concentrations face many technical issues including the need to consider chemical reactions in the atmosphere. Therefore, as it now stands, estimating the impact at individual projects is difficult, so it is critical to pay attention to future initiatives and technological developments.

### **1.1.2 Characteristics of offensive odors**

The main sources of offensive odors are factories and business establishments including livestock farms, sewage treatment plants, pulp manufacturing facilities, and establishments engaged in painting or printing processes. Similar to air pollutants, offensive odors are carried and spread by the air itself, so the effect of offensive odors is greatly influenced by the type of generating source, conditions in the areas where the offensive odors are carried and spread, and air movement (wind direction and velocity).

Environmental impact assessments for offensive odors can apply similar forecast methods as those used for air quality, though forecasts based on similar cases in line with the characteristics of the source can also be applied. Forecasts based on similar cases must examine similarities to and differences from the project, and the reasons for selection as a similar case must be clearly stated.

Offensive odors emitted from factories and business establishments are regulated under the Offensive Odor Control Act (Act No. 91 of 1971). In the past few years, the government has been tackling the further introduction of offensive odor index regulations that can also deal with complex odors and other urban offensive odor issues as an alternative to the traditional regulations covering each specific malodorous substance.

### 1.1.3 Characteristics of noise and Infrasound<sup>1</sup>

Of the different kinds of pollution, noise is a problem that is closely linked to our everyday lives. Motor vehicles, railroads, aircraft, construction work, and factories and workshops are just some of the myriad sources of noise. Infrasound is sound at a frequency of 20Hz or lower and is lower than the range of audible frequencies for most humans (20Hz–20kHz), but the problem is that it can cause glass windows and doors, and shoji doors to vibrate, and research is being conducted into this phenomenon, including the effect it has on human health.

Sources of noise are classified into fixed sources including factories and workshops, ventilation towers, and windfarms, and mobile sources such as motor vehicles, aircraft, and railroads, while sources of infrasound include road bridges, dam water discharge, tunnel exits, and large boilers. Noise and infrasound are propagated through the air (atmosphere), and this can have an effect on the human body and other objects.

The effect that noise and infrasound has on the human body and the features of its propagation vary depending on frequency, so consideration must be given to these diverse conditions. There is a broad range of methods for forecasting noise, and include propagation theory formula, empirical regression formula, model experiments, and reference to similar cases. Environmental and regulatory standards relating to noise are set according to the generating source, and it is important to keep in mind that assessment indicators are different for each source. Infrasound can be forecast using propagation theory formula and reference to similar cases, but here we must be mindful that it is difficult to judge at the planning stage whether the facility etc. will be a source of infrasound or not, that it is difficult to determine the source even when measuring the infrasound, and other infrasound characteristics.

Environmental standards relating to aircraft noise (Environment Agency Notification No.154 of 1973) were amended in December 2007 under which the previous “WECPNL” assessment indicators, which were based on maximum noise levels and aircraft numbers, were changed to the time-zone weighted equivalent noise level “ $L_{den}$ ”. The amendment took into broad consideration technological advances in noise measuring instruments and the fact that assessment indicators based on equivalent noise levels such as  $L_{den}$  had become the prevailing method internationally, and came into force on April 1, 2013.

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<sup>1</sup> Infrasound: While the definition of “low frequency noise” varies from country to country, in Japan, the term has been customarily used for “generally 100Hz or lower”. The IEC (International Electrotechnical Commission) 61400 Standards series defines sound of 20Hz or lower as infrasound, and that between 20Hz and 100Hz as low frequency noise, and based on this, JIS C 1400-0:2005 (Wind Turbine Generator Systems - Part 0: Glossary Of Terms For Wind Turbine Generator System) has the same definition. Accordingly, competent ministry ordinances prescribing technical guidelines for individual business types under the Environmental Impact Assessment Act are consistent with international definitions, and regulate noise (including noise of a frequency of 20–100Hz), and infrasound (noise of a frequency of 20Hz or lower). The term “low frequency noise” is not used.

In this light, this guide refers to noise of 20Hz or lower as “infrasound”, and noise outside of this frequency range (including noise of a frequency of 20–100Hz) as “noise”.

#### **1.1.4 Characteristics of vibration**

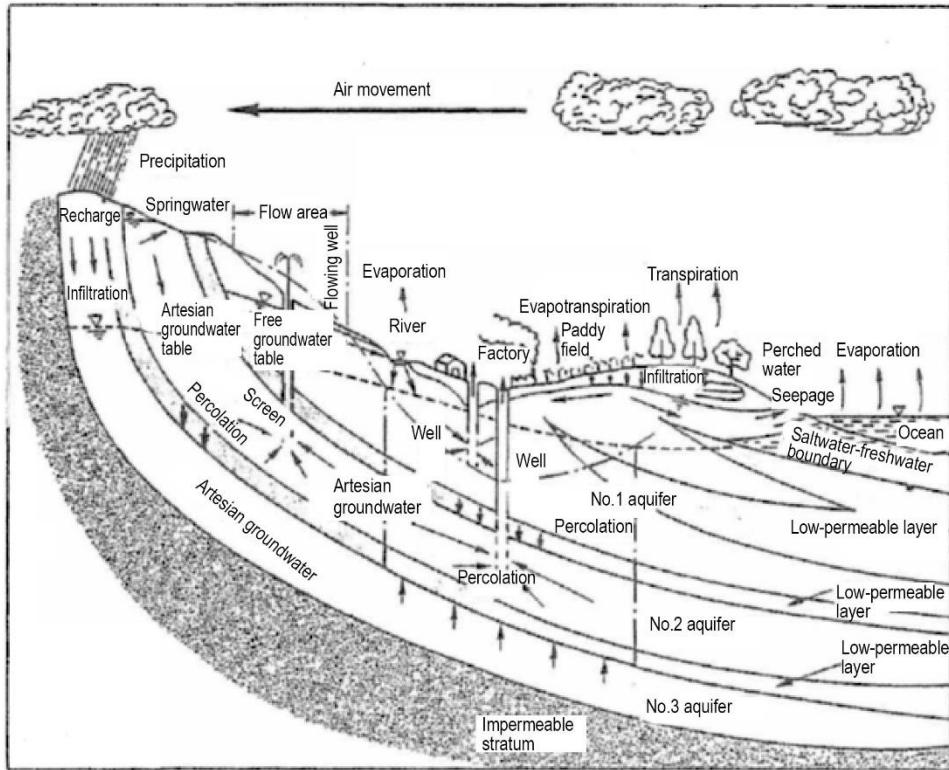
Similar to noise, vibration is a pollution issue that is closely linked to our everyday lives. The diverse range of vibration sources include motor vehicles, railroads, construction work, and factories and workshops, and it is important to set monitoring areas according to source characteristics. Vibration is propagated through the ground or buildings and structures and can have an effect on the human body and various objects, and vibration propagating in buildings and structures as structure-borne sound can radiate within rooms and the like to become a noise problem. As with noise and infrasound, the effect that vibration has on the human body and the features of its propagation vary depending on frequency, so there is a need to consider vibration survey, forecast and evaluation methods that accord with these diverse conditions.

There is a broad range of methods for forecasting vibration, including propagation theory formula, empirical regression formula, and reference to similar cases. Regulatory standards relating to vibration may be set according to the generating source, so it is important to keep in mind that evaluation indicators are different for each source.

## **1.2 Water environment**

The major environmental components in the water environment classification under the Environmental Impact Assessment Act are water quality, bottom sediment, and groundwater.

As shown in Figure I.1-1, terrestrial water takes various forms within the natural water cycle process, including precipitation, surface water, groundwater, and soil water, and these various forms are closely linked. The Water Cycle Act, promulgated in April 2014 (Act No.16), stipulates in the fundamental principles of the water cycle process that water sustains life on earth and fulfills a critical role in national life and industrial activities; when using water, consideration must be given to avoiding or minimizing any impact on the water cycle so as to maintain water cycle health; and the water cycle within watersheds must be comprehensively and uniformly managed over the entire watershed. Following promulgation of the Act, in July 2015 Cabinet approved the Water Cycle Basic Plan, which will form the basis of policy dealing with the water cycle in Japan.



Data: Underground rivers, Katsuyuki Fujinawa (1989), Rural Culture Association Japan

**Figure I.1-1 The water cycle**

The water cycle fulfills a vital function in securing the necessary volume of water for sustaining human life and activities and the workings of nature, transporting heat and various substances, climate mitigation through evapotranspiration from vegetation and water surfaces, water purification through the soil or water flow, and maintaining a diverse ecosystem. Recent years have seen a sharp change in the water cycle against a backdrop of a rapid population and industrial concentration in cities and expanding urban areas, changes in the industrial structure, depopulation, aging and a declining birthrate, and climate change, and this has, in turn, given rise to a host of issues including a decline in groundwater recharge and purification functions, increase in pollution load from general sources of pollution in urban areas during precipitation, and a lowering of the groundwater level.

Environmental impact assessments to date have largely focused on the condition of water-related environmental component such as water quality and quantity in a limited range of “locations” including rivers, lakes and marshes, marine waters, and aquifers. However, in the face of the growing environmental issues due to changes in the water cycle stated earlier, environmental impact assessments should view the diverse forms of surface water and groundwater as a single interrelated “water cycle system”, and look to minimize the impact that anthropogenic change to this system has on the various water cycle functions and resources. It is important to keep in mind that the traditional idea in environmental impact assessments of focusing on a single aspect of the water cycle system may make it difficult to fully grasp the impact on the water cycle.

In recent years, more research has been conducted into water environment models for the purpose of managing the water environment over entire watersheds. The majority of environmental impact assessments are generally conducted for water cycles smaller than the watersheds used in water cycle models, but there is a need to examine scope and methods of analysis that are suitable for individual projects, taking into consideration water behavior over the entire watershed. When using water cycle models and other advanced methods, there is a need to be fully aware that if unrealistic parameters are applied, there is a high risk that the credibility of the analysis will be badly diminished. As the water environment is a core element of any ecosystem, impact assessments on the natural environment must give consideration to the relationship between the environmental impact on the water environment and that on fauna, flora and the ecosystem. In addition to the ecosystem, consideration must also be given to the relationship between the water environment and waterside areas where people come into recreational contact with nature.

Water environmental impact assessments should begin from the perspective of whether the project could have an impact on the water cycle system, and if it is believed that there will be no impact on the system, for example, if it is considered that even though the pollution load from the project will alter the water environment of “locations” such as rivers, lakes, marshes, and marine areas, there will be no change to the water cycle system, the assessment will focus on the impact on the water environment at the “location”, as it has in the past. When a change in ground surface cover will seriously alter the balance of water supply from precipitation to surface water, soil water and ground water, a change in water storage or the watershed will significantly alter the river flow rate, the construction of a large underground structure in a groundwater flow area or discharge basin will adversely affect groundwater flow, and other cases where a change to the water balance of the various conditions that constitute the water cycle system is envisaged, the assessment should focus on the water cycle as necessary.

### **1.2.1 Characteristics of water quality**

Factors that have an impact on water quality include artificial drainage, and changes in water flow conditions due to the establishment of structures in the water area. Traditional environmental impact assessments have been conducted primarily from the viewpoint of protecting human health and conserving the living environment, and have viewed a change in water quality in a water area due to artificial drainage as a change in condition at a given time or location. However, considering that water circulates within the environment, it is important to understand the kind of water cycle system that the water area in question falls under and how substances are circulating when looking at changes in water quality, and thought must also be given to the impact on bottom sediment, the soil environment, and the ecosystem, which are all related to water quality. Moreover, when considering water quality as the condition of substances in the water cycle system, the environmental impact assessment must take into account the fact that the condition is accompanied by change, and

also the characteristics of that change. If artificial drainage is an impact factor, it is preferable to examine a suitable monitoring structure during the project's service stage.

The environmental standards concerning water pollution are standards relating to the protection of human health (health items) and those relating to the conservation of the living environment (living environment items). In 2003, environmental standards relating to the conservation of aquatic life were established in the living environment items, and at present, three items have been set—total zinc, nonylphenol, and linear alkylbenzene sulfonates and their sodium salts. In 2016, bottom layer dissolved oxygen (bottom layer DO) was added as a living environment item. Effluent from factories and business establishments is regulated under the Water Pollution Prevention Act (Act No.138 of 1970), and prefectural ordinances prescribing more stringent standards under this Act.

In areas of public waters, the rate of achievement of water quality environmental standards relating to the protection of human health (health items) has remained steady at around 99% in recent years, while among the environmental standards relating to the conservation of the living environment (living environment items), the rate of achievement for biochemical oxygen demand (BOD) and chemical oxygen demand (COD), key indicators of organic pollution, has been steadily improving, reaching 89.1% in fiscal 2014. By water area, the rate of achievement in closed water areas such as lakes, marshes, inland bays and inland seas continues to fall below that in rivers and coastal waters. The rate of achievement for total nitrogen and total phosphorus has hovered at quite a low level of around the 50% mark since fiscal 2008 in lakes and marshes, and has been around the upper 80% mark since fiscal 2013 in marine waters.

### **1.2.2 Characteristics of bottom sediment**

Bottom sediment is a medium that accumulates or elutes chemical substances relating to water pollution, and is both a vital element of the water environment, and a habitat for fish, shellfish and other benthic organisms, and seaweed and water grasses.

Environmental impact assessments have focused on the impact that dredging and drilling works in bottom sediment containing hazardous substances have on water quality, and changes in bottom sediment itself that accompany variations in water flow conditions caused by the use of weirs and the occurrence of submerged areas. Since bottom sediment is closely linked to water quality, there is a need to examine survey, forecast and evaluation methods with a view to this interrelated effect.

### **1.2.3 Characteristics of groundwater**

Traditional environmental impact assessments have evaluated changes in the condition of individual environmental components—water quality and groundwater—caused by the project, but this has been little more than grasping a single aspect of the vast water cycle system, and for the most part, there have been no detailed examinations concerning changes in the volume of groundwater recharge through the soil zone following changes in land use

and other factors and any resulting changes in groundwater flow, any impact arising in the groundwater discharge basin, and water behavior and any changes in the soil zone, which is also the interface with the ecosystem.

Groundwater flow is different from air quality, noise, and surface water in that countermeasures are extremely difficult to implement after the project has been completed, so preventing or reducing the environmental impact during the planning stage is especially important. Such planning considerations must also be carried over to environmental impact assessments during the implementation stage.

In fiscal 2013, the rate at which environmental standards relating to groundwater pollution were exceeded was highest at 3.3% for nitrate-nitrogen and nitrite-nitrogen, which are primarily caused by fertilizers, livestock waste and domestic effluent, while new cases of pollution of volatile organic compounds, which are mainly emitted by factories and workshops, continue to be reported. In 2011 the government amended the Water Pollution Prevention Act to set framework standards for preventing groundwater pollution by hazardous substances, and through this, local governments are pushing ahead with comprehensive measures to tackle groundwater pollution by nitrate-nitrogen and nitrite-nitrogen that are in line with local needs and conditions.

### **1.3 Soil environment**

The major environmental components under the soil environment classification in the Environmental Impact Assessment Act are topography and geology, ground, and soil.

#### **1.3.1 Characteristics of topography and geology**

Topography and geology are included in environmental impact assessments from an environmental conservation perspective, and ministry ordinances that stipulate technical guidelines for individual business categories under the Environmental Impact Assessment Act position “topographical and geological features that are important from a scientific or rarity perspective” as “important topography and geology”.

Important topography and geology should be selected with reference to features designated in laws and ordinances or recorded in literary sources, opinions of experts in the local environment, and also with full consideration to the various grounds for selection and regional characteristics.

For example, attention must be given not just to features designated by laws and ordinances as areas of scenic beauty and the like under the Act on Protection of Cultural Properties, but also to those designated natural wilderness conservation areas etc., those taken up as landscape resources in literature, and those of educational importance for geomorphic research. Environmental impact assessments to date have included the effect of land reclamation on the coastal topography, so there is a need to ensure that selection of the feature/facility to undergo environmental impact assessment is flexible and appropriate, taking into account characteristics of the project or area.

### **1.3.2 Characteristics of ground**

Natural ground is classified into rock (bedrock), earth and sand, and soft ground, while embankments and reclaimed land are referred to as artificial ground. Regardless of whether it is natural or artificial, ground has the capacity to support surface and underground structures, buildings, living organisms and all other loads, and along with its function as building material, ground forms the site for the construction and development of various facilities that serve as the foundation for life and production. As human activities expand, the scope of ground use expands, both in area and depth.

In projects subject to environmental impact assessments, the function of the ground will change due to the alteration of the land through land cutting, filling and reclamation, or the groundwater environment. This also has an impact on the environmental components connected with this. So when conducting ground-related environmental impact assessments, it is important to give broad consideration to land subsidence, as well as landslides, slope failure, liquefaction, ground collapse and other changes in land stability due to development activities, or changes in the geothermal environment caused by underground structures, and physicochemical change including the generation of hazardous gases.

Ground where such changes are prone to occur are widely distributed in lowland plains where population, social activity and social capital are concentrated, and here these changes can expand to cause damage. Once ground subsidence or ground deformation occurs, recovery is virtually impossible, so it is particularly important to prevent or reduce the environmental impact at the planning stage.

Ground subsidence is a consolidation phenomenon that occurs when the ground contracts due to a drop in the groundwater level or groundwater pressure caused by excessive groundwater extraction or construction works, and a non-destructive phenomenon that occurs over time. Ground subsidence causes such damage as leaning of houses, exposure of building foundations, damage to underground pipes, poor drainage, and emergence of zero meter zones or marshy areas. Ground subsidence is a relatively mild phenomenon and occurs gradually, so in a sense it can be difficult to notice. Localized ground subsidence, or cracking and sinking can occur due to construction works, but these are shear fractures, so here they are referred to as “ground deformation”, and are distinct from “ground subsidence” mentioned before.

### **1.3.3 Characteristics of soil**

Soil has a functional aspect of maintaining the base environment for ecosystems, mitigating terrestrial, hydrological and meteorological phenomena, and filtration and material absorption, and a resources aspect in which soil is used as agricultural and afforestation material, and civil engineering and construction material.

Soil-related environmental impact assessments have focused primarily on soil contamination. Soil contamination occurs along routes used for moving pollutants, such as

areas where material or solvents containing hazardous substances are stored or used, and areas where waste is treated. It is also important to note that there is naturally occurring soil contamination arising from mineral deposits or features of the geological strata, and new effects on the surrounding environment caused by hot spring development and other construction works. The impact that soil contamination has on the surrounding environment is quite diverse, and includes not only human health, but the living environment and ecosystems as well. Environmental impact assessments should therefore take into full account the characteristics of soil pollutants, surrounding land use, water systems, and other local conditions.

Soil takes an exceedingly long time to form, so if soil importance is stated in literature and other references from a scientific or rarity perspective, there is a need to consider incorporating this into the environmental impact assessment as necessary. Soil is also an important habitat for living organisms ranging from higher plants to soil life and microorganisms, and also has the function of filtration and material absorption, so when conducting environmental impact assessments relating to plants, animals and ecosystems, it is important to consider habitat and the other functional aspects of soil as necessary.

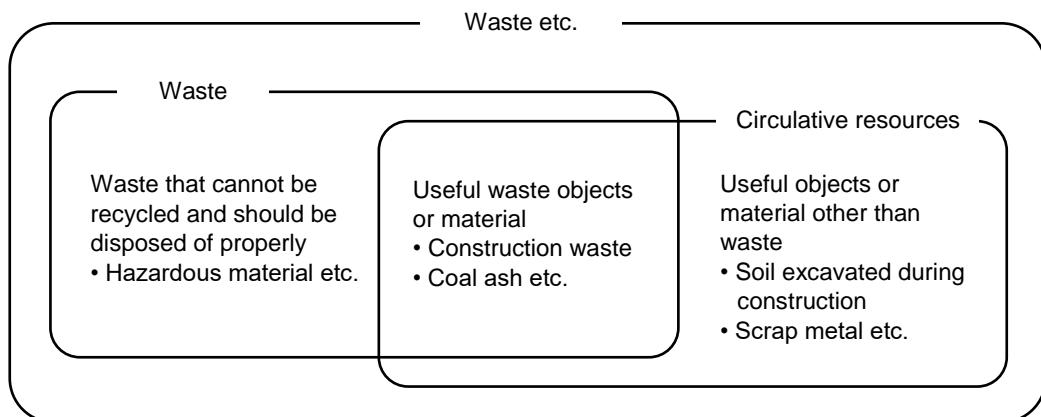
An increase in redevelopment of old factory sites saw a rise in soil contamination from heavy metals and volatile organic compounds, so in May 2002 the government promulgated and enacted the Soil Contamination Countermeasures Act (Act No. 53). In 2009, the Act was amended to expand the system for determining the state of soil contamination from April 2010. Advanced notification became mandatory when altering the form or nature of land over an area of 3,000 m<sup>2</sup> or more, and when there is a risk of soil contamination, the prefectural governor may direct that a soil contamination investigation is to be carried out. It is desirable that environmental impact assessments become more efficient through linkage and coordination with other related systems such as this.

## 2. Environmental load

### 2.1 Characteristics of waste

The Waste Management and Public Cleansing Act (Act No. 137 of 1970) defines waste as “refuse, oversized refuse, combustion residue, sludge, excreta, waste oil, waste acid, waste alkali, animal carcasses and other waste material or discarded items in a solid or liquid state”. The Basic Act on Establishing a Sound Material-Cycle Society (Act No. 110 of 2000) defines waste etc. as “waste” and “articles previously used, articles collected without having been used, or articles disposed of, or derived incidentally in the course of manufacturing, processing, repairing, or selling products, in supplying energy, in construction in civil engineering and architecture, in agricultural and livestock production, and in other human activities. The Act also defines circulative resources as “useful waste objects or material”. Environmental components treated as waste etc. under the Environmental Impact Assessment Act are shown

in Figure I.2-1, and, in addition to waste, include useful waste objects or material such as soil excavated during construction and scrap metal.



**Figure I.2-1 Range of waste etc. under the Environmental Impact Assessment Act**

Previously, environmental impact assessments relating to waste etc. applied the generated volume of waste etc. for forecasting and evaluating, but with the 2005 amendment of the basic items aimed at establishing a sound material-cycle society, environmental impact assessments now examine recycling and other disposal methods for waste, and focus on the final disposal volume. It is therefore preferable to give greater priority to examining the reduction and reuse of waste in environmental impact assessments based on the Master Plan for Establishing a Sound Material-Cycle Society.

## 2.2 Characteristics of greenhouse gases

To gain a proper understanding of the load on the environment relating to the conservation of the global environment, there is a need to look at greenhouse gases, usage of tropical timber, and the volume of ozone depleting substance emission.

Greenhouse gases and ozone depleting substances generated or tropical timber used during project implementation, together with other project activities, ultimately have the potential to give rise to change on a global scale that may have an impact on the entire global environment, and a characteristic of this is that there is a time-space interval between “factor” and “result”.

**Table I.2-1 Major greenhouse gases and examples of emission sources**

Major greenhouse gases	Global warming potential	Emission sources
Carbon dioxide (CO <sub>2</sub> )	1	Operation of construction machinery, use of motor vehicles, ships and aircraft, operation of power plants, fuel combustion at factories, etc.
Methane (CH <sub>4</sub> )	25	Fuel combustion, waste disposal facilities, sewage treatment facilities, etc.
Nitrous oxide (N <sub>2</sub> O)	298	Operation of construction machinery, use of motor vehicles, ships and aircraft, waste disposal facilities, etc.
Hydrofluorocarbons (HFCs)	E.g.) HFC-134a 1,430	Cleaning of manufactured goods, foaming agents, etc.
Perfluorocarbons (PFCs)	E.g.) PFC-14 7,390	Semiconductor industry, aluminium industry, etc.
Sulfur hexafluoride (SF <sub>6</sub> )	22,800	Semiconductor industry, light metals industry, etc.
Nitrogen trifluoride (NF <sub>3</sub> )	17,200	Semiconductor industry, liquid crystal panel manufacturing industry, etc.

Note: Global warming potential is sourced from the Enforcement Order of the Act on Promotion of Global Warming Countermeasures (Cabinet Order No. 135 of 2015).

**Table I.2-2 Major ozone-depleting substances and examples of emission sources**

Major ozone-depleting substances	Ozone depleting potential	Examples of emission sources
Chlorofluorocarbons (CFCs)	0.6–1.0	Refrigerants, foaming agents, cleaning agents for electronic components, etc.
Halon	3.0–10.0	Fire extinguishings
Carbon tetrachloride	1.1	Raw material for CFC etc., solvents
1.1.1 Trichloroethane	0.1	Cleaning agent for metal components etc.
Hydrochlorofluorocarbons (HCFCs)	0.005–0.52	Refrigerants, foaming agents, cleaning agents for electronic components, etc.
Hydrobromofluorocarbons (HBFCs)	0.01–14	Fire extinguishings
Bromochloromethane	0.12	Pharmaceutical intermediates, solvents
Methyl bromide	0.6	Soil fumigants, quarantine fumigants

Note: Ozone-depleting potential is sourced from the Enforcement Order of the Act on the Protection of the Ozone Layer Through the Control of Specified Substances and Other Measures (Cabinet Order No. 411 of 2014).

Measures to tackle greenhouse gases have become more important with every passing year, and in 1992 the United Nations Framework Convention on Climate Change, in 1997 the Kyoto Protocol, and in 2015 the Paris Agreement were adopted. The Paris Agreement states the aim of reaching a global peaking of greenhouse gas emissions so as to strike a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, so reducing greenhouse gas emissions will become even more critical.

It is important to adopt optimum available technologies relating to greenhouse gases, and conduct environmental impact assessments that take into account national reduction targets and action plans formulated by local governments. It is also important to reduce greenhouse gas emissions over the entire business cycle from extracting raw materials and material manufacturing through to construction, operation, removal, and renewal.