Pakistan Environment Protection Agency
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Sectoral guidelines for environmental reports— Major sewerage schemes

Contents

SECTORAL GUIDELINES FOR ENVIRONMENTAL REPORTS
MAJOR SEWERAGE SCHEMES

1. INTRODUCTION

1.1 Scope of Guidelines

This guideline identifies and explains issues that should be addressed for a sewerage system proposal. It is important to focus on key issues for specific proposals. By addressing relevant matters identified in this guideline there should be sufficient information for the assessment of most sewerage system proposals.

Sewage consists primarily of water containing wastes from residential uses, including water from toilets, cooking and washing, usually conveyed in a pipeline (sewer). These sources are also present in commercial, recreational and tourist facilities. Chemical and organic wastes from industrial processes are sometimes accepted into sewerage systems, though care must be taken of the composition of such industrial waste, which can interfere with the efficient treatment of human wastes, and make the re-use or disposal of the treated products difficult.

A sewerage system:

- collects and transports sewage
- treats sewage to a required level

uses, disposes of, or discharges effluent, biosolids, methane or any other products from the sewage treatment process, returning them to the environment.

1.2 Context

This guideline is part of a package of regulations and guidelines which include:

- The Pakistan Environmental Protection Ordinance 1997
- Policy and procedures for filing, review and approval of environmental assessments
- Guidelines for the preparation and review of Environmental Reports
- Guidelines for public participation
- Guidelines for sensitive and critical areas
- Pakistan environmental legislation and the National Environmental Quality Standards (NEQS)
- Sectoral guidelines for environmental reports: ***Major Sewerage Systems***

Pakistan environmental legislation and the National Environmental Quality Standards (NEQS)

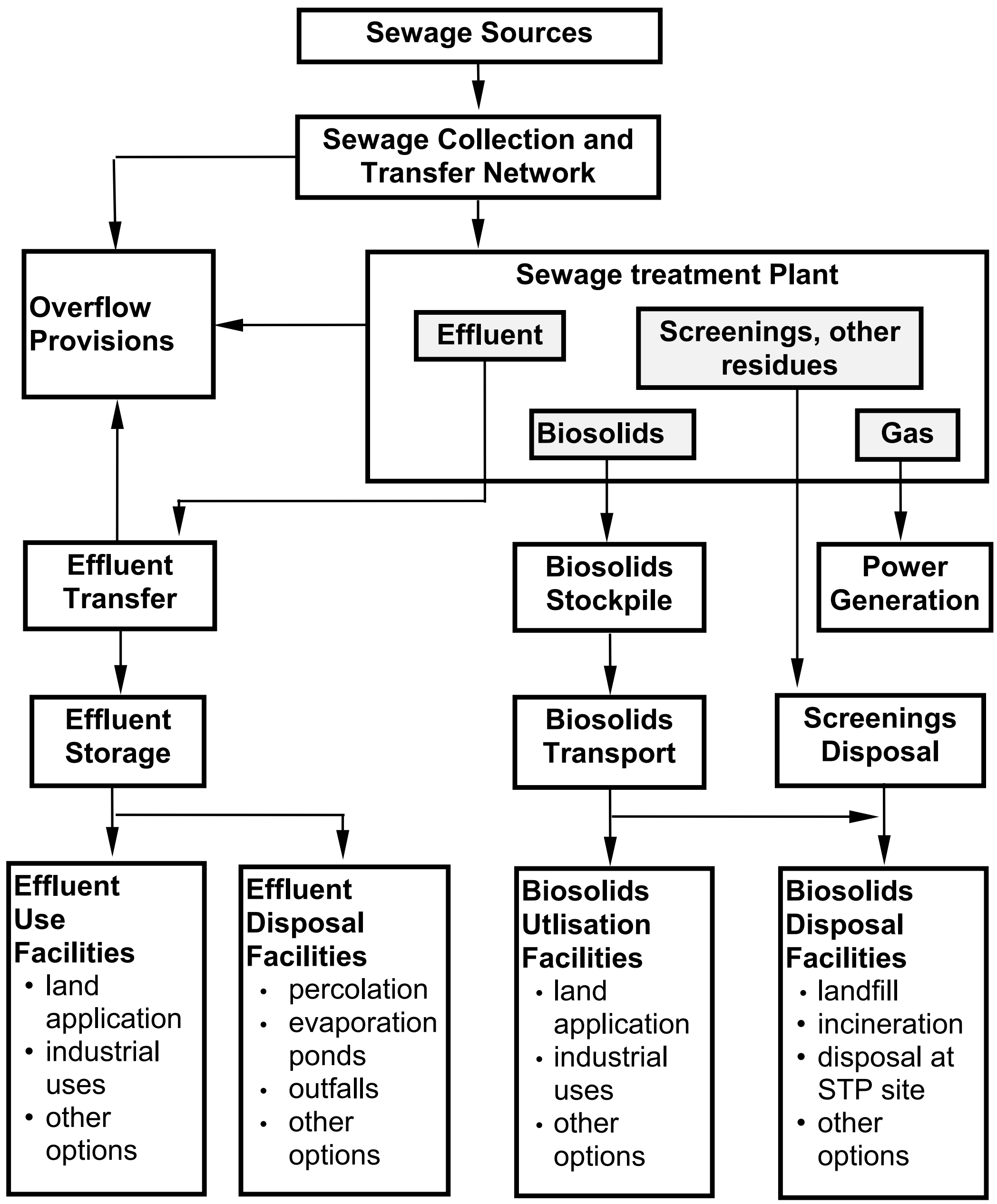
This guideline should be read in the context of the overall package.

It should be noted that by far the majority of sewage generated in Pakistan is presently untreated: which represents a very real problem for public health. There are few sewage treatment plants already constructed, although two plants providing primary and secondary treatment exist in Karachi (at Mahmoodabad and the SITE Industrial Area) and another is under construction (the Mauripur treatment facility).

2. SECTOR OVERVIEW

Figure 1 illustrates the general components of a sewerage system:

Figure 1: Sewerage System Components



Sewage collection and transfer refers to sewage from generating sources being conveyed to a treatment plant through networks of pipelines, tunnels, pumping stations, and intermediate storage tanks.

Sewage treatment refers to the process of making sewage safe for release to the environment, which in Pakistan will require meeting target effluent standards set in the

NEQS. Treatment processes range from simple physical screening and aeration to sophisticated biological, chemical, or advanced physical treatment using membrane technology and bioengineering methods. In particular:

Primary treatment prepares the sewage for biological treatment. Large solids are removed by screening, and grit is allowed to settle out. Oils, greases and suspended solids are removed by flotation, sedimentation, or filtration.

Secondary treatment is the biological degradation of soluble organic compounds, by aerobic or anaerobic processes.

Tertiary treatment is added to remove certain specific types of residuals which may be incompatible with the beneficial uses of receiving waters. Tertiary treatment includes the "polishing" of treated effluent to further remove chemical or biological contaminants, and make it suitable for re-use.

Treated effluent transfer is conveyed through pipelines or tunnels, with or without pumps, to the site of its use, temporary storage, or final disposal.

Treated effluent storage prior to use may be necessary before land application (e.g., during wet weather inability of land to accept effluent). (Overflow may occur when storage capacity is exceeded.)

Treated effluent use may include:

- agriculture;
- landscaping;
- forestry; or

process water in industrial plants.

Final disposal of treated effluent may include all the uses listed above, and:

- evaporation basins;
- sand exfiltration;
- purpose built outfalls;

discharge in rivers or oceans.

Biosolids processing and stockpiling is related to by-products of various sewage treatment processes. Biosolids are the solid materials resulting from filtration, settling and evaporation processes in the sewage treatment plant, combined with physical and chemical degradation, to form a sludge. Biosolids processing is done to transform biosolids to form usable products by processes such as composting. Stockpiling of solid residues from sewage treatment process may be required before transfer off-site.

Biosolids and other solid residues transport off-site occurs in:

- semi-liquid form in tankers, or

in a drier sludge form in covered dump trucks.

Use of treated biosolids is applicable as soil conditioners and applied to land e.g., in agriculture, forestry, or landscaping. Some industrial processes may also use treated biosolids.

Final disposal of biosolids, screening, and other solid residues can be achieved through the uses listed above, and through the following options:

- landfill— screening, residues, and excess biosolids at approved landfills
- on-site disposal—for excess biosolids at approved on-site facilities

incineration—screening, residues and excess biosolids may be burnt in an approved incineration facility.

Gas Collection & Use refers to methane and other gases generated during the process of treatment of sewage which can be collected and used to generate power. If use of gases for power generation or heating is not feasible, they may be flared to prevent accumulation and the risk of explosion.

3. POTENTIAL IMPACTS ON THE ENVIRONMENT

3.1 Positive Impacts

Sewerage schemes prevent or alleviate the adverse effects of the pollutants, on the human and natural environments. If properly carried out, their overall environmental impact is extremely positive. The positive impacts include:

- improvement in receiving water quality, and
- increases in the beneficial uses of receiving waters

abatement of nuisances and public health hazards in the serviced area.

Installation of a wastewater collection and treatment system provides an opportunity for more effective control of industrial wastewater through pretreatment and connection to public sewers and offers the potential for beneficial reuse of treated effluent and sludge.

Other indirect positive impacts include:

- the provision of serviced sites for development
- increased fishery productivity and revenues
- increased tourist and recreational activity and revenues
- increased agricultural productivity and/or reduced chemical fertilizer if treated effluent and sludge are reused, and

reduced demands on other water sources as a result of effluent use.

Some potential positive impacts can be incorporated quantitatively into analyses of the costs and benefits of various alternatives during the feasibility/planning stage of the project.

For instance human health benefits can be measured, by estimating avoided costs in the form of health care expenditures and lost workdays which would result from poor sanitation. Reduced drinking and industrial water treatment costs and increased fishery, tourism and recreation revenues can serve as partial measures of the benefits of improved receiving water quality.

3.2 Negative Impacts

Major sewerage schemes need to be carefully planned, sited, designed, constructed, operated, and maintained; otherwise projects are likely to have a negative impact overall, and will fail to yield the full benefits for which the investment was made and will adversely affect other aspects of the environment.

Municipal wastewater pollutants include:

1. suspended and dissolved solids; consisting of inorganic and organic matter
2. nutrients
3. oil and grease
4. toxic substances, and
5. pathogenic microorganisms.

Urban stormwater can contain the same pollutants, sometimes in high concentrations.

Human wastes that are not properly treated and are disposed of at the point of origin or are collected and carried away pose risks of:

1. parasitic infections (through direct contact with fecal material)
2. hepatitis and various gastrointestinal diseases

cholera and typhoid (through contamination of water supplies and food).

When waste water is collected but not treated properly before disposal or reuse, the same public health hazards exist at the point of discharge. If such discharge is to receiving water, additional harmful effects will occur (e.g., habitat of aquatic and marine organisms may be further harmed by toxic substances, which may spread to higher organisms through bio-accumulation in food chains).

If the discharge enters confined waters such as a lake or bay, the nutrient content can cause eutrophication, with plant growth and toxic algael blooms which can disrupt fisheries and recreation. Solid waste generated in wastewater treatment such as grit, screenings, and primary and secondary sludge can pollute soil and groundwater if not properly handled.

Offensive Odors Site selection for sewage-treatment plants is a particularly sensitive issue. While a well operated sewage treatment plant should cause little off-site odour, in practice off-site odour problems are common. If the treatment plant is close to a residential area, offensive odors can be a significant impact for the locals.

Soil erosion Land clearing including tree-felling during the construction phase can result in significant soil erosion. This can lead to consequent deterioration of water quality downstream . It is necessary to study whether downstream water utilization is hampered by massive outflows of soil from open ground created in the construction of the facility, and appropriate measures should be adopted.

Noise Sewage-treatment plants may generate significant noise and a buffer zone, or a sufficient separation distance, should be provided between the plant and sensitive land uses to abate the noise generated.

Sludge Disposal The sludge produced at a sewage-treatment plant should be disposed of in an appropriate manner. Wherever possible, it should be used productively (e.g. as an additive to the composting of green waste). Other disposal methods include land fills, sited in areas of low permeability with deep ground water tables, or built with impervious linings.

Natural Environment Issues
The ecology
The effect of project pipelines and access roads on valuable habitat for flora and fauna can be significant and should be studied, and appropriate measures adopted.
Effect on landscape
The impact of the project on unique landscape values (and especially on the view from main viewpoints) can be affected and should be studied, and appropriate siting and screening measures adopted.

Construction The location of installations and equipment, work method, and the work period should be arranged so that the execution of the project work will cause the least inconvenience in the area and effect on the environment during construction period.

3.3 Planning considerations

For major sewerage schemes there are several characteristics common to many of the potential impacts and mitigating measures which need be emphasized as special issues throughout project preparation, assessment, and implementation phases. They include:

1. sound and comprehensive wastewater system planning;
2. fundamental dependence of wastewater projects on proper operation and maintenance;
3. selection of appropriate technology;
4. necessity for an effective industrial wastewater pretreatment program in any municipal system serving industrial customers; and finally

need to consider a number of potential socio-cultural impacts which are sometimes ignored in project preparation.

Wastewater volume and strength are basic information required for the planning process. Realistic projection of volume is important to establish the magnitude and timing of the need for collection and treatment.

The type and location of effluent discharge and the level of treatment are crucial and should not be made without adequate information. In making and updating projections, other planned development activities should be taken into account so that extensions or expansions of wastewater infrastructure can be coordinated with them.

4. IMPACTS AND MITIGATION MEASURES

4.1 Sewerage Scheme Planning

Treatment Level Pollutant removal standards are usually expressed as concentration of regulated substances permitted in the treatment effluent. In the case of effluents which are to be applied to crops or otherwise used on land, the standards are set to prevent crop and groundwater contamination. The National Environmental Quality Standards (NEQS) are reproduced in the "*Pakistan environmental legislation and the National Environmental Quality Standards (NEQS)*".

Phased Construction Phasing of projects can be conducted:

1. within individual wastewater systems;
2. as part of a long-term pollution abatement program; and

in relation to activities in other sectors.

Constructing a collection system without treatment works, however, merely concentrates harmful discharge in a different location and is a frequent cause of gross pollution of surface waters. Similarly installing public water supply and proceeding with residential, commercial or tourist development will cause a public health hazard or water pollution if sewage infrastructure is not provided at the same time.

It is often cost-effective to construct treatment works by allowing for additional capacity in future as the collector system is extended and new connections are made. Phasing wastewater investments can be a realistic way to make progress toward ultimate water quality objectives especially in densely populated, highly polluted areas, where a single massive project would exhaust all resources available for public works in the region.

The level of treatment can be phased in a single project or as part of sector strategy. This approach which is helpful when environmental improvement is urgently needed but local financial resources are limited, or the scientific data to determine exactly the extent of pollutant removal required has not been collected.

It is important in any phased approach that in acquiring sites and designing facilities, space is reserved for future expansion.

Sludge Management and Treated sewage reuse Sewage treatment generates sludge and other solids waste, such as grit, and grease screenings. Finding locations for landfill or incineration, or outlets for recycling, is often difficult. However, if solutions are not found, a portion of the pollutants removed from the sewage treatment will become pollutants of the land. Sludge management should be part of sewerage scheme planning.

Systems in which treated sewage or sludge are reused may be more expensive to construct and operate than those in which the sludge is disposed of as a waste product. In evaluating alternatives involving reuse, however, it is important to include such benefits as:

- increased water availability to support development in the region
- the opportunity to diminish irrigation demands on potential public water supply sources
- reduced need for chemical fertilizers
- incremental improvements in crop and timber production, and
- low cost means to re-vegetate marginal soils or reclaim them for agriculture or silviculture

These too can often be measured, most of them by calculating avoided costs.

Selection of Appropriate Technology The sewage treatment environment is a hostile one for electronic, electrical and mechanical equipment. Maintenance is a never-ending process, and it requires support - spare parts, laboratories, trained technicians, specialized technical assistance, and adequate budgets.

Simpler systems, selected and designed with maintenance in mind, which provide more reliable service, should be the first consideration in choosing treatment plant and pumping station technology. Local institutions must be able to manage the sanitation programs and systems. The simpler technologies, selected for ease of operation and maintenance, will be less expensive to construct and operate.

Table 1 in below shows that a variety of siting and technical alternatives exist for wastewater collection, treatment and disposal, and sludge management. Several alternatives will be applicable in most situations.

Table 1: Siting and technical alternatives for sewage collection, treatment, disposal, and sludge management

Collection Systems	Treatment Works Components	Effluent Disposal	Sludge Management
• on-lot treatment • individual holding tanks with truck collection • small-diameter gravity, pressure or vacuum sewers • shallow sewers • flat sewers • simplified sewerage systems • conventional gravity sewers and force mains • regional collection systems • community or sub-regional systems	• community on-lot systems • oxidation ditches • stabilization ponds • aerated lagoons • artificial wetlands (or constructed wetlands) • land treatment • conventional biological treatment • physical-chemical treatment • primary or secondary treatment with ocean disposal	• reuse in agriculture, silviculture, aquaculture, landscaping • reuse for groundwater recharge • rapid infiltration • underground injection • reuse in industrial applications • ocean outfall • surface water discharge • night-soil treatment plants	• composting • composting with municipal refuse • reuse in agriculture or silviculture • reclamation of marginal land for reforestation, cultivation • energy recovery • incineration • landfill • ocean disposal

Many impacts can be avoided altogether or mitigated more successfully and at less cost by thoughtful site selection. Section 2.6 on site selection in the *"Guidelines for the preparation and review of environmental reports"* should be read in conjunction with this section.

Industrial Wastewater Providing that industrial liquid wastes are pre-treated to remove substances which may interfere with the digestive capacity of a sewerage plant, industrial waste sources may be connected to public sewer systems. Such action reduces the number of discharge points and thus the complexity and cost of monitoring and enforcement. This provides the opportunity for better control of industrial effluent, and also may lower the total cost.

A critical success factor, however, is an industrial pretreatment program. This program should include:

1. regulations with specific limits on discharges of hazardous and toxic substances and other pollutants to public sewers
2. monitoring procedures, and
3. enforcement capability.

Without a suitable industrial pretreatment program:

- there is a risk of exposing water system personnel and components to hazardous materials
- disrupting the treatment process, and
- transporting toxic pollutants to receiving waters or the land, and contaminating treatment plant sludge so severely it cannot be put to beneficial use, or even disposed of without difficulty.

Depending on the quality of pre-treatment, it may be acceptable to discharge the treated industrial waste through storm water systems.

4.2 Water Quality

4.2.1 Surface Water Discharge

For surface water discharges, standards depend on the classification of intended end-use. The water quality standards may range from “very clean natural waters” to “suitable for cooling water in industry and agriculture”.

Classification of waters should be conducted with consideration for what is economically and technically realistic; requiring drinking water quality will seldom be a sound use of pollution control resources.

Water quality issues are important for proposals where:

1. discharge is directly or indirectly into a water body
2. use of effluent or biosolids for land application, or
3. discharge onto land likely to be inundated with flood waters.

Release of treated water from the sewage-treatment plant should be positioned with sufficient consideration as to its effects on downstream water usage or other water utilization. Special attention should be paid to the water supply intake when one is located nearby.

In such cases the mitigation measures should consider:

- the existing condition of the proposed discharge water body compared with the relevant water quality objectives and standards;
- levels of appropriate water quality parameters which could be impacted by the sewerage scheme; including nitrogen, phosphorous, chloride, BOD, fecal coliforms and salinity levels;
- description of the potential sources of pollution and assessment of the pollution characteristics, magnitude, and probable frequency of pollution events, and the assimilation capacity of the receiving environment, including:
  a) intentional or accidental discharges, leakage, seepage, spillage, bypass or

overflow of raw or treated sewage from outfalls, flood inundation, failure or overload of the reticulation system, plant or treatment process, storage facilities, artificial wetlands, effluent or biosolid use schemes, or any other reasons;

b) sedimentation from construction activities and the operation of the treatment site or effluent or biosolid application sites;
c) discharge or waste from workshops, vehicle washing facilities, plant and equipment, fuel and chemical storage;
d) an assessment of the impacts of any discharge in flow regimes as a result of the proposal on water quality; if dredging or disturbance of the sediments on the water quality and control measures to minimize impacts.

- the potential impacts on other users of the water bodies or oceans by the change of water quality;
- an assessment of the adequacy of the design and management measures to minimize impacts including those to:
  - ⇒ prevent the release of raw or partially treated sewage or effluent into the environment; minimize or avoid the uncontrolled release of treated sewage or effluent into the environment;
  - ⇒ manage any leachate or stormwater run-off at the sewage treatment, biosolids storage or effluent and biosolids utilization sites including appropriate buffers or management systems to prevent contamination of surface water, including return of any leachate or effluent to storage or treatment of water prior to release;
  - ⇒ minimize sedimentation erosion;
  - ⇒ contain any algal bloom in the effluent storage facilities;
  - ⇒ prevent contamination of water from accidental spillage of petroleum products or other chemicals.
- a plan for ongoing maintenance and monitoring of water quality controls for each component of the sewerage scheme to ensure their correct installation, operation and effectiveness
- a monitoring program for the proposal site as well as at nearby natural water bodies (upstream, adjacent and downstream) or oceans likely to be affected by point sources or non-point run-off from the site
- potential cumulative impacts on water quality from other activities with similar impacts.

4.2.2 Groundwater

Groundwater issues are particularly important when:

a) the groundwater level is high;
b) a component of the proposal is located near a recharge area, or
c) the soil is highly permeable.

The groundwater Impact mitigation strategy should include consideration of:

- the depth to the water table, regional and local groundwater gradients; the location of any recharge areas, seeps, and springs;
- overlying geology, and the physical characteristics and size of the groundwater resource;
- groundwater quality compared with relevant water quality standards; (including nitrogen, phosphorus, salinity and chloride levels);
- location and nature of any rising groundwater or salinisation problems in the area;

an assessment of the potential for the effluent irrigation scheme to contribute to the rising groundwater levels in the area or any other salinity problems;

- an assessment of the potential risk of contamination of groundwater given the proposed design, management and location of:
    a) the treatment plant and reticulation scheme;
    b) effluent and biosolids storage, utilization or disposal facilities;
- the location of any nearby bores, current and potential users and uses of groundwater in the area; an assessment of the potential impacts on existing and future uses of groundwater in the area;
- an assessment of the adequacy of proposed measures to prevent contamination of groundwater; the proposed monitoring program.

4.2.3 Marine waters

In the past, oceans have been regarded as common sinks of unlimited capacity, where sewage effluent and other wastes can be dumped indiscriminately. While such behaviour has always resulted in contamination of fisheries and beaches, the very capacity of the ocean to accept untreated wastes is not unlimited. No sewage discharge should be contemplated to land, rivers or the ocean without at least primary treatment, and desirably secondary treatment.

Limitations on discharges to marine waters focus on:

1. minimising discoloration of the water;
2. pollution by oil and grease;
3. floating solid waste material;
4. bacteria and viruses(in shellfish harvesting, and recreational waters);
5. heavy metal and other contaminants.

For marine water discharge the major planning task is to identify an acceptable location for the submerged outfall. The limitations include the effluent will not degrade significant water areas or contaminate shellfish beds, and beaches.

Mathematical models should be used to simulate the processes of dilution, dispersion, diffusion, stratification and pollutant decay or die-off. The models require current, temperature, salinity and water quality data collected over a full 12-month cycle, along with detailed bathymetric and ecological information. Data collection and modeling are costly and time-consuming. However, in comparison to the capital and operating costs over the expected life of wastewater systems, both the costs and time may be relatively small, and the benefits are substantial. Data collection can sometimes occur in parallel with design and construction activities when wastewater projects are phased as described below.

For sewerage systems undertaken within the coastal zone, the following mitigation measures should be considered:

- impacts from sewage treatment and management activities on beaches or coastal dune fields including from short-term erosion or long-term recession
- potential to pollute beaches given the location and type of outfall (e.g. cliff face, deep ocean)
- any potential for the effluent discharge to affect coastal sand migration or disturb sea bed ecology
- direct or indirect impacts on coastal wetlands
- potential impacts of the cultural, recreational, scenic, natural and tourism values/activities of the affected coastal area.

Based on the above measures, appropriate action to reduce environmental impacts should be given high priority.

4.2.4 Flooding

For sewerage systems undertaken on flood prone areas, the following issues should be considered:

- flooding status including the likely frequency of flooding
- if flood liable:
  a) the direction of flood flow;
  b) the vulnerability of the plant, to inundation or damage;
  c) potential impacts from inundation or damage facilities;
  d) the potential for the proposal to increase the flood liability of surrounding land by any land formation or leveling, construction of dams or bunding; an assessment of potential impacts of any increased flooding levels;
- any future proposed flood mitigation systems that may influence the impacts of the proposal on the environment.

4.3 Soils

Soil issues are particularly important if:

a) major earthworks are to be undertaken
b) hazardous chemicals have previously been used on the site or are to be used on site
c) effluent and biosolids are to be applied to the land
d) acid sulfate soils are to be disturbed, or
e) the soils are highly erodable.

Proposed measures to manage or mitigate any adverse impacts and a proposed monitoring regime for erosion and sedimentation should include:

- measures to minimize the area denuded at any one time
- stormwater drainage and sediment control
- stabilization works for cuttings, embankments, trenches and open channels
- earth material management measures including wind and water erosion control measures or minimizing the stockpiling of soil
- the maintenance program of all erosion control works

The proposed management program to mitigate potential impacts from any biosolid or effluent land application scheme should include:

- the management of product characteristics to be used on site
- the monitoring program of soil and crop responses
- response strategies should deleterious impacts be observed

4.4 Flora and fauna

Flora and fauna issues are of particular relevance when terrestrial or aquatic vegetation is to be cleared, disturbed or affected by a change in water quality or quantity, or fauna habitats are likely to be disturbed.

Issues to consider include:

1. terrestrial and aquatic plant, animal or fish habitats that may be directly or indirectly affected by the proposal
2. the local and regional scarcity of these habitats, ecological communities, populations and species and their potential scientific, historic or cultural significance
3. potential impacts on the number, size, distribution, interrelationships or health of

species, populations or ecological communities or their habitats as a result of killing or disturbance from clearing, and changes in water quantity, quality or the groundwater regime.

4. the sensitivity of species, populations or ecological communities to disturbance, particularly considering the timing of the disturbance relative to breeding/migratory cycles of species; the potential for recolonisation following rehabilitation, the time require for re-establishment; the impacts on remnant vegetation, for example wildlife corridors;
5. if relevant, the potential impacts on the commercial and recreational value fish stock and on any aquaculture activities
6. an assessment of the potential impacts on biodiversity including the cumulative impacts of the proposal on communities in the region; significance of any disturbed vegetation or fauna for other biota not directly affected by the proposal, but which interact with potentially disturbed vegetation or fauna
7. details of any existing weed, vermin or pest problems; the impact of the proposal on their numbers; a description of measures to control and prevent infestations at or adjacent to the site; if the proposal involves artificial wetlands, assessing the potential impact from the introduction of any non-indigenous plant species; the potential for species to become 'weeds'; if an irrigation or biosolid application scheme is proposed, the potential to increase weed problems
8. the mitigation of impacts, such as the provision of new appropriate habitats or compensatory rehabilitation or restocking of indigenous species; the opportunities for recolonisation; timing of major disturbances so as to minimize impacts; details of any proposed methods to protect species or their habitats from accidental damage during construction or operation of the proposal; timing of major disturbances to minimize impacts on breeding and migration cycles;
9. whether the presence of open water bodies associated with the sewerage treatment plant (such as lagoons) will attract large numbers of water fowls and migratory birds, and whether these will have any adverse impact on surrounding land uses such as airports.

4.5 Health and Safety

Public Health For Health issues the mitigation strategy should consider the following:

- the public health risk associated with the existing conditions;
- an assessment of potential improvements to community health as a result of implementing the scheme;
- assessment of the potential health implications of the proposal considering impacts on air quality, water quality, soil contamination, road safety and the potential for the transmission of viral, parasitic and bacterial pathogens including:
  a) an assessment of potential exposure pathways from the release of raw or unsatisfactorily treated sewage
  b) assessment of the adequacy of buffer zones from dwellings, recreational areas and public roads given the potential health risk
  c) an assessment of the adequacy of management and mitigation technology proposed, and the proposed monitoring program

Air quality Air quality issues to consider as part of the mitigation response include fixed and mobile sources of odor, dust, and methane.

The sources may include treatment of sewage and biosolids, accidental release of chemicals, storage of effluent and biosolids, incineration of biosolids or solid waste and digester gas.

The likely impact of the proposal on the local and regional air quality; if a significant issue, should include:

a) baseline data on the ambient quality of the air

b) the projected quantity, frequency and times of emissions.

Meteorological conditions should be assessed under which nearby dwellings and sensitive land area are likely to be affected, and the frequency of occurrence of these conditions

Mitigation and management measures to control the generation and impacts of odor, fumes dust, aerosols and other air pollutants should include:

a) the use of site layout design including screens, installation and provision of buffer zones to reduce impacts

b) the use of management practices such as: control measures on open stockpiles, processing and loading areas; sealing or watering of roads; algal management on effluent storage dams.

Monitoring programs should be designed and implemented for dust and odor, and if incineration is proposed, stack emissions should be monitored as well.

Chemical hazards For sewerage systems which use, store or generate potentially hazardous chemicals such as chlorine, alum, lime, nitric or sulfuric acid, methane, fuels or explosives on the site during either the construction or operation stages, the following issues should be considered:

1. a list of dangerous goods/hazardous chemicals to be used or generated and their quantities and rate of usage or generation
2. an identification of possible causes of potentially hazardous incidents, the likelihood of occurrence and their consequences to public safety or the environment
3. details of storage, usage and transport arrangements for the hazardous materials, with an outline of operational and organizational safety controls to reduce their hazard risk and environmental impacts
4. a brief description of operational and emergency procedures involving dangerous and hazardous goods

Dam safety hazards For sewerage systems that store effluent in dams for irrigation or other water utilization schemes, assess:

1. the performance of the dam during exposure to natural hazards such as flooding and severe storms
2. the impacts of subsidence or earthquakes on the integrity of any proposed dam
3. the impacts on the biophysical and human environment should the dam be inundated or ruptured.

4.6 Socio-cultural Impacts

Sewage treatment facilities require land; and can lead to involuntary resettlement. The treatment and disposal works can cause nuisance in the immediate vicinity. Often, the lands and neighbourhoods selected are those of “vulnerable groups” who can least afford the costs of dislocation and whose living environment is already impaired.

Care should be taken to site and manage treatment and disposal facilities so that:

1. odors or noise will not disturb residents or other users of the area
2. resettlement, if required, is managed with sensitivity, and
3. project mitigation plan include provisions to mitigate or offset adverse impacts on the human environment.

If these considerations are not included in project planning, there is substantial risk of solving one community’s environmental problem by transferring it to another.

The mitigation plan for social issues should consider:

a) an assessment of the affect of the proposal on future development in the catchment; the potential impact on the settlement patterns, community structure or cohesion

b) the potential impacts of the construction or operation on the amenities of the area considering factors such as disruption to any existing services or recreational areas, temporary loss of access and disruption of traffic

c) social equity considerations such as means to offset any inequities for the host community

d) any other issues raised in community consultation.

Visual Issues For sewage schemes where visual impacts are a concern, issues to consider include:

- visibility from the surrounding areas; consideration of the site in the context of any landscapes of local or regional significance;
- potential visual impacts caused by the clearing of vegetation, the treatment plant, biosolids stock piles or other structures, or by lights for security and night operations.

The proposed mitigation and management measures to reduce visual impacts should include landscaping and visual treatment plans.

Heritage Heritage issues are relevant if the impact on heritage will occur as a result of the proposal. Issues which may need to be considered include; identifying any items of heritage significance on the site (including underwater) and in the area affected by the proposal. This should include two steps:

Step 1: collate information from any relevant heritage study or conservation plan for the site or area - this source may need to be supplemented with information from the following:

a) relevant historical research on the area

b) consultation with any local historical society, or cultural study group and the local council

c) inspection of heritage registers, schedules, databases or lists, Heritage Council Register, heritage and conservation registers, local or regional environmental plans

Step 2: survey the area likely to affected, to identify any items of potential heritage significance.

For natural heritage:

a) assess the heritage significance of any natural areas including geological or palaeonotological features or ecological communities

b) assess the potential impact of the proposal on the heritage significance

c) propose measures to mitigate impacts or to conserve the heritage significance. If natural areas of heritage significance are to be disturbed a conservation management plan may need to be prepared in consultation with the relevant authorities.

Consider the acceptability of impacts on heritage significance and assess the adequacy of the measures to mitigate impacts during all stages of the proposal.

4.7 Cumulative impacts

Cumulative impacts may result from a number of activities with similar impacts interacting with the environment in a region. They may also be caused by the synergistic and antagonistic effects of different individual impacts interacting with each other. These may be due to the temporal and/or spatial characteristics of the activities and impacts. Issues to consider that relate to sewerage system proposals include, in particular, effluent and biosolids use or disposal. The following factors should be considered:

a) any other point or non-point sources of nutrients or other pollutants in the immediate river or ocean catchment;

b) any other existing or planned sewage treatment facilities adopting similar effluent or biosolids utilization or disposal options; consideration of any cumulative impacts due to oversupply of effluent or biosolids;

c) the potential cumulative impacts of land application practices on any sites where effluent or biosolids are proposed to be used or within any catchment;

d) consideration of the receiving environment's ability to achieve and maintain the water quality objectives established for that system.

5. EMISSION REQUIREMENTS

The NEQS requirements represent the basic minimum standards that should apply to all projects. More stringent emission requirements are appropriate if the environmental assessment indicates that the benefits of additional pollution controls outweigh the additional costs involved. In particular, if the environmental assessment establishes, for one or more of the pollutants covered in this document, that:

a) the baseline exposure of significant populations within the air-shed exceeds the trigger value for ambient exposure, and

b) the proposed project will result in significant worsening in this exposure level,

then the Responsible Authority may require the project comply with stricter emission requirements, or it may require alternatives to reduce emissions from other sources to mitigate ambient exposures within the air-shed.

6. MONITORING AND REPORTING

The monitoring program should provide information about actual impacts and early warning information of unacceptable environmental conditions. Baseline data collection methodology is covered in *Section 3.4 of the "Guidelines for the Preparation and Review of Environmental Reports".*

An operational monitoring program should be developed to observe trends in:

1. influent volume and composition;
2. hazardous substances entering treatment works;
3. enforcement of industrial pretreatment conditions;
4. control of the treatment process;
5. management of the treatment plant performance;
6. environmental quality at disposal locations; and
7. sludge products and reclaimed wastewater quality.

Particular attention should be given to adherence to the mitigation plan provisions to protect stream channels, beaches and wetlands.

In designing the monitoring program, the emphasis should be on supporting sound operations of the wastewater system. This entails establishment of system performance standards Data should be collected to monitor attainment of those standards, interpreted and then delivered efficiently and in a timely manner to the system's operators and managers.

7. MANAGEMENT AND TRAINING

Institutional support is critical to successful wastewater utility operation. It begins with staffing. A large collection and treatment system will need:

1. a manager with technical and administrative experience
2. an environmental engineer
3. supervisors and workers in operations
4. sewer maintenance and plant maintenance crafts
5. laboratory directors and technicians; and
6. support staff in accounting, budgeting, and clerical areas.

If the project includes on-site disposal systems, holding tanks or small-diameter sewers with settling tanks, staff will be needed to develop and enforce standards for the facilities, and to inspect and approve installations, and there will have to be provision for on-site system maintenance.

A customer relations unit is essential to receive and investigate customer complaints, provide information to customers, and conduct education programs related to the system's services (e.g., hygiene and sanitation, on-site system upkeep). If the utility is responsible for revenue collection, a billing and collections group will be required.

Training should begin before system start-up, with the assistance of a design consultant. Training should include:

1. operations and maintenance training on the actual equipment
2. basic familiarization with the system
3. its relationship to the environment, and
4. fundamentals of occupational health and safety.

Industrial waste control staff will need training on operation and maintenance of pretreatment equipment

A start-up plan should be prepared for any new wastewater facility of significant size to ensure that the requirements described above are met. The start-up plan should provide for:

- assembling staff
- maintenance equipment and spare parts in advance of need
- training all personnel, and
- establishing revenue sources and budget.

References

The development of these guidelines rely heavily on the following sources:

- Government of Pakistan EIA Guidelines 1986
- ADB Guidelines 1993
- World Bank EIA Guidelines 1994
- The UNEP EIA Training Resource Manual June 1996
- New South Wales EIS Guidelines 1997

Checklist of environmental parameters **APPENDIX I**
Major sewerage schemes

Actions Affecting Environmental Resources and Values	Damage to Environment	Recommended Feasible Measures
Sewerage Scheme Planning		
Inappropriate level of treatment adopted	Major impact on natural systems and human health	Review proposed treatment level, consider phased construction
Sewage collection system constructed without treatment plant provision	Concentrates harmful discharges.	Ensure sewerage schemes are implemented in their entirety, even where they are phased in.
Inappropriate sludge disposal	Pollution of land and water environments.	Adopt disposal by reuse or in safe landfills.
Treated effluent disposal	Wastage of scarce resources.	Reuse should be considered wherever practical and economic.
Selection of appropriate technology	Equipment failure resulting from inadequate maintenance makes sewage treatment ineffective.	Choose system components which are compatible with technical skills available for maintenance.
Adding industrial wastewater to the sewage load.	Heavy metals, chemicals and oils can impair sewage treatment processes, and contaminate treated effluent and sludge.	Pre-treatment of industrial wastewater is essential if it is to accepted as an input to a sewage treatment scheme.
Water Quality		
Overflow/bypassing hazards	Contamination of the environment, health hazards	Proper design, operations, management, & monitoring
Process failure or leakage	Contamination of receiving waters	Design with adequate margin of safety
Groundwater pollution	Adverse effect on beneficial uses, health hazards	Proper design, operations, management, & monitoring
Ocean outfalls	Contamination of marine life, fouling of beaches and health hazards.	Adequate treatment prior to discharge, and correct siting and design of outfall.
Flooding	Widespread contamination	Proper design

APPENDIX I (Continued)

Actions Affecting Environmental Resources and Values	Damage to Environment	Recommended Feasible Measures
Soils		
Construction impacts	Erosion, ground failure	Good design and construction practices
Effluent and biosolid application to land	Soil and crop contamination	Monitoring and management
Flora and Fauna		
Construction impacts	Sedimentation, changes to water balance and water quality	Control measures for erosion, good planning and design
Health and Safety		
Toxic gases in sewers, and hazardous materials in sewage	Serious health and safety hazards	Careful operations, management and monitoring
Inadequate treatment, and unsafe reuse practices	Public health risks	Site security, good operational management and monitoring, adequate buffer areas
Dust and odour problems	Nuisance and public health	Buffer areas, operational management and monitoring.
Chemical storage and use	Health and safety hazards	Operational and emergency procedures for dangerous and hazardous chemicals.
Dams for storing treated effluent for irrigation	Inundation or rupture of dam	Adequate design of structure and spillway capacity.
Socio-cultural		
Inadequate resettlement	Social inequities	Adequate resettlement planning and budgeting
Development in proximity to the sewage treatment works.	Adverse effects on settlement patterns, sterilization of high quality land	Adequate planning and good siting.
Visual impacts	Impairment of landscape quality	Good siting, and landscape restoration plans and screen planting.
Destruction of cultural or heritage sites	Loss or impairment of these cultural values	Alternative siting of facilities, documenting heritage sites which cannot be avoided.
Cumulative Impacts		
Cumulative impacts in conjunction with other activities	Long term and widespread environmental deterioration	Proper understanding of capacity of the system to absorb impacts.