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REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF HOUSING BUILDING
PLANNING AND URBAN DEVELOPMENT (CIPTA KARYA)

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MEDAN URBAN DEVELOPMENT, HOUSING, WATER SUPPLY AND SANITATION PROJECT

TECHNICAL MEMORANDUM NO.30

ENVIRONMENTAL ASSESSMENT OF WATER SUPPLY AND SANITATION SYSTEMS

This is a draft of Section 14 of the Master Plan Report for Water Supply and Sanitation

NOVEMBER 1979

ENGINEERING - SCIENCE, INC. • SINOTECH ENGINEERING CONSULTANTS, INC
A JOINT VENTURE
in association with
PADCO and P.T. DACREA

MEDAN URBAN DEVELOPMENT, HOUSING, WATER SUPPLY AND SANITATION PROJECT

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Our ref.: 79/1199/MUDS/313 8 November 1979

Director General Cipta Karya
Ministry of Public Works
Jalan Pattimura 20
Kebayoran Baru
Jakarta Selatan

Subject: Technical Memorandum No. 30, Environmental Assessment

Dear Sir:

Attached are 20 copies of the subject Technical Memorandum for your information and review. The material contained in this memorandum constitutes submission of Section 14 of the draft Master Plan for Water Supply and Sanitation Report.

Yours faithfully,

ENGINEERING SCIENCE INC. MEDAN URBAN PROJECT INDONESIA

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LIST OF TECHNICAL MEMORANDA PREVIOUSLY SUBMITTED

Report No.	Title	Date Submitted
1.	Preliminary Site Selection Criteria for Perumnas Medan III, SSCH/LCH Project	March, 1979
2.	Work Plan for Water Supply and Sanitation Master Plans and Feasibility Studies	April, 1979
3.	Policy Issues for Project Guidance	March, 1979
4.	Drainage - Principal Rivers and Rainfall Analysis	May, 1979
5.	Preliminary Evaluation of Sunggal Water Treatment Plant	May, 1979
6.	Public Health Considerations	July, 1979
7.	The Present Drainage System	August, 1979
8.	Recommended Drilling Program	August, 1979
9.	Medan Household Income/Expenditures	August, 1979
10.	Existing Land Use in Medan	August, 1979
11.	The Regional Functions of Medan	August, 1979
12.	Existing Solid Wastes Systems and Projected Solid Wastes Characteristics	August, 1979
13.	Evaluation of Medan Master Plan	August, 1979
14.	Physical Constraints to Urbanization	August, 1979
15.	Development in Health Care in Medan	September, 1979
16.	Existing Water Supply Systems	September, 1979
17.	Developments in Education	October, 1979
18.	Existing Water Supply and Sanitation Systems	October, 1979
19.	Public Health and Environmental Aspects	October, 1979
20.	Alternative Solid Wastes Management Systems	October, 1979

BEST AVAILABLE DOCUMENT

LIST OF TECHNICAL MEMORANDA PREVIOUSLY SUBMITTED (CONTINUED)

Report No.	Title	Date Submitted
21	The Distributed Investment Strategy Plan (DISP)	October, 1979
22	Recommended Solid Wastes Management System	October, 1979
23	Recommended Drainage Management System	October, 1979
24	Alternative Water Supply Management Systems	November, 1979
25	Water, Wastewater, Stormwater and Solid Wastes Systems	November, 1979
26	Alternative Wastewater Management Systems	November, 1979
27	Design Criteria and Bases for Cost Estimates	November, 1979
28	Recommended Water Supply Management System	November, 1979
29	Recommended Wastewater Management System	November, 1979

SECTION 14

ENVIRONMENTAL ASSESSMENT

14.1 INTRODUCTION

The objective of an environmental assessment is to provide an evaluation of the effects which proposed facilities and operations will produce within the project study area. Since the level of detail for recommended projects developed under these investigations is much more general than that provided for actual construction projects, the assessment of environmental effects will focus on major effects. Most project effects will be largely beneficial but some will be adverse.

The major impacts of the recommended plans are focused on improved urban development and housing and on the development of water supply, drainage, wastewater collection, and solid waste management systems to support these recommended urban improvements. The combined effects of the plans will be to improve urban aesthetic values, support more coordinated and compatible land uses, and improve the standard of urban life and public health within Medan.

Adverse effects will arise primarily from urban expansion, withdrawal of large amounts of water from the rivers and groundwater basins, discharge of greater quantities of drain water and sewage, and collection and disposal of large volumes of solid wastes. Improvements of local living standards and expanding employement opportunities will increase the attraction of Medan for citizens of the secondary communities and the rural areas of North Sumatra. Induced attraction of population and resulting growth may exceed projections used in plans, and the recommended infrastructure may not be able to adequately reach the proposed levels of service and benefits.

The Medan Urban Development Study (MUDS) has conducted a coordinated study of the development of overall urban growth, major low and middle income housing and residential improvements, and the major urban ulities which support both the urban growth and housing for the urban poor. The study has not included provision of energy from electricity and natural gas.

Urban growth for the study area was projected from historic trends and the influences of planned and funded projects and population growth. Locations of housing projects have reflected the projected improvements and new housing needs over the next five, ten and twenty years. Utility requirements have been largely determined by the projections of urban and population growth to the year 2000. The location and size of water supply, sewerage, drainage, and sanitation facilities were determined by the projected requirements, existing facilities, and physical limitations and characteristics of the area.

14.2 SCOPE OF THE ASSESSMENT

As defined in the regulations for U. S. Agency for International Development (USAID), the scope and level of detail in an environmental assessment are more limited than those of an environmental impact statement. Generally, the scope of the assessment is directed toward the major adverse effects of various recommended projects and their operations. The level of detail within this environmental assessment has been limited by the existing and available data which are few and often of questionable accuracy or reliability.

This environmental assessment has been organized to be integrated within the Master Plan report, and it is not intended to stand alone. Several of the standard elements of an environmental assessment (project description, alternatives to the proposed action, beneficial effects of the proposed action) are described in detail in the previous sections and the details are not repeated in this section.

14.3 PROJECT ELEMENTS

The recommended projects have been developed to improve existing poor urban conditions to provide better urban life for the Medan citizens. Major project aspects which relate to environmental effects are presented below.

14.3.1 Urban Development Plan

The recommended urban development plan has focused on the projection of existing trends for the next five years and on a recommended development strategy for 1985 and to the year 2000.

The projections and recommended strategy diverge from the existing year 2000 Master Plan with its diffused residential development by concentrating the urban growth. The MUDS projection of a year 2000 population of 1.9 million is significantly lower than the previously projected level of 2.4 million. The urban plan projects an expansion of land use in commerce by 95 percent, in industry by 44 percent, and in institutions by 78 percent with an additional non-residential area of about 7.7 km^2. An expanded employment base is indicated by construction of more than 28 km^2 of new urban structures in addition to many major public works projects. Capital facilities projects will create employment and stimulate economic activity. Public works projects which will provide employment and greater importance to Medan include :

- Belawan Port expansion
- Trans-Sumatra Highway, Medan-Belawan Toll Road, and Ring Road
- Airport relocation
- Railroad improvements and urban transit
- Major public works projects recommended in the MUDS Master Plans for Medan (Medan III, pipelines, drainage channels treatment plants)

The recommended urban development plan used the following guidelines for defining development and reserved areas. Expansion of Medan should be concentrated within a few kilometres of the planned Ring Road and Toll Road except along the Tanjung Morawa-Siantar Road, the Deli Tua Road, and the Brastagi Road. Urban expansion should be extend west of the Belawan River and outside of the Belawan corridor (between the Deli River and Toll Road).

Several guidelines reflect potential development costs for many areas and potential governmental costs for providing utility services and flood protection. Watershed protection for the Sunggal Water Plant involves both water quality or public health conditions for potable water supplies and costs for additional treatment requirements for removing urban pollutants.

14.3.2 Housing

Several housing projects have been developed during the Medan study for imrpovement of existing low income housing and for development of a new housing project. The Kampung Improvement Program (KIP) will improve roads, paths, drainage, water supply and solid waste collection for 260 ha of low income housing in seven districts of central Medan. The KIP will add new health, educational, and financial services to the recommended areas and to the adjacent UNDP area. These recommended areas have a population of about 85,000 which is expected to grow to over 100,000 by the year 2000.

The Low Cost Housing/Sites and Service Program will develop a new housing site of 125 ha near the Brastagi Road. The site will contain about 7,500 lots for an eventual resident population of 40,000 (gross density: 320 persons/ha). Parcels will vary in size, degree of improvement, and conditions of acquisition (e.g. government service, private sale or rental). Utilities and public services will be within the site, but major commercial and transportation facilities will develop along the Brastagi Road.

14.3.3 Water Supply

Development of the future water supply incorporated the projections of urban growth and distribution, significant users, water demands, and the governmental goals for service. These were then compared with the supply capacity of existing facilities, and the net requirements were used to determine recommended supply and distribution facilities:

1. Expanded Sunggal Water Plant (130,000 m^3/d)
2. A new Deli Tua Water Plant (150,000 m^3/d)
3. Sibolangit Springs (46,000 m^3/d)
4. 100 deep water wells
5. Six ground level reservoirs with booster pumps
6. 290 km of new major pipeline construction (300 mm or larger)
7. Administrative and technical buildings and housing for employees

Operations would include normal requirements for such facilities, training programs and extensive water flow and quality monitoring in the four major rivers, the groundwater aquifers, and throughout the supply system.

runoff and the rapid urban runoff and high flows in the Deli and Babura rivers may cause river flow to spill over the banks and flood the surrounding areas. Recommended drainage projects will reduce ponding within the drainage system area and reduce overbank flooding along the river for storms of 1 to 5 year return frequency.

Recommended drainage projects include:

1. cleaning of drains along 520 km of city street in 57 km^2 in Medan.
2. cleaning channels of the Deli, Babura, Sikambing, and Kera rivers within the urban area.
3. long-term cleaning, bank protection and in some areas, dredging along the Deli, Babura, and Percut rivers and along main and major drains.

Maintenance of two to five year flood flows through existing drains and stream channels has been the primary goal of this recommended system. In the phased program, flow monitoring of the cleaned channels would provide more representative data on flood flows; these flow data would then be used to define where selected improvements should be made.

14.3.6 Solid Wastes

Recommended solid waste collection and disposal will be vastly improved throughout all of Medan. About 300 km^2 will be served by daily collection by trucks or carts. Cart collection from about 3,000 neighborhood storage sites will convey refuse to about 290 truck loading facilities, one per square kilometre. Refuse collected by or transferred to trucks will be delivered to a recommended Belawan disposal site, unless a closer site with similar land and development costs can be found. By the year 2000, up to 800 hectares of disposal site would be filled with compacted refuse.

Daily solid waste collection will increase from 150-200 tonnes up to 1,850 tonnes. The effective collection area will expand from about 25 km^2 to about 250 km^2. A fleet of about 325 trucks will be required.

The service objectives of the recommended water system are to quadruple the service population with building connections and with public standpipe supply to at least 20 percent of the year 2000 population. Total served population will reads 1.5 million (or 80 percent of the total study area population). Service would also be improved by increasing water pressure throughout the expanded service area and providing normal operating pressures throughout the average day and in most areas during the maximum day demand. Storage would provide for peak hour demands and for emergency supplies.

14.3.4 Wastewater

Existing sanitary waste disposal involves individual treatment of sanitary wastes, which are separated from general wastewaters. Septic tanks with subsurface soil absorption and pit latrine systems are widely used in residential areas. In the central area, some commercial and institutional buildings provide onsite treatment (septic tanks) before disposal to the storm drains, but some sanitary wastes are discharged directly to the sewers. Existing practises will be allowed to continue in many areas because costs of water-borne sanitary waste collection, treatment and disposal are beyond the local financial capacity.

The recommended wastewater system will provide collection, transmission, treatment, and disposal for about 90,000 m^3/d of sewage from a service area in central Medan of about 21.4 km^2. About 175 km of street sewers will collect sewage and discharge it into about 30 km of major interceptor sewers. A regional sewer will convey the sewage to the treatment facility north of the existing urban area. The facilities will consist of 90 to 130 ha of waste stabilization lagoons. Secondary treated effluent will be discharged to the Deli River.

14.3.5 Drainage

Development of drainage projects largely reflects the types and intensity of land use rather than population levels. Existing drains are often clogged with solid wastes and otehr debris or are of insufficient size to remove rainfall, and flooding in many areas causes inundation of residences and roads. Urban development typically increases the

runoff and the rapid urban runoff and high flows in the Deli and Babura rivers may cause river flow to spill over the banks and flood the surrounding areas. Recommended drainage projects will reduce ponding within the drainage system area and reduce overbank flooding along the river for storms of 1 to 5 year return frequency.

Recommended drainage projects include :

1. cleaning of drains along 520 km of city street in 57 km^2 in Medan;
2. cleaning channels of the Deli, Babura, Sikambing, and Kera rivers within the urban area; and
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Recommended solid waste collection and disposal will be vastly improved throughout all of Medan. About 300 km^2 will be served by daily collection by trucks or carts. Cart collection from about 3000 neighbourhood storage sites will convey refuse to about 290 truck loading facilities, one per square kilometre. Refuse collected by or transferred to trucks will be delivered to a recommended Belawan disposal site, unless a closer site with similar land and development costs can be found. By the year 2000, up to 800 ha of disposal site would be filled with compacted refuse.

Daily solid waste collection will increase from 150-200 tonnes up to 1,850 tonnes. The effective collection area will expand from about 25 km^2 to about 250 km^2. A fleet of about 325 trucks will be required.

14.4 ENVIRONMENTAL EFFECTS

Environmental impacts of the recommended plans involve both beneficial and adverse effects. Benefits largely arise from the improvement of the urban life for almost two million people in Medan by the year 2000. Significance of this improvement is enhanced since about 75 percent of those benefitting will be the urban poor who have the least personal means of improving their standard of living.

Adverse effects primarily result from effects of construction. However, some adverse effects may result from the operation of the water supply and the drainage and solid waste systems in conformance with the recommended urban plan. Knowledge of these adverse effects and planning for their mitigation or elimination will depend upon data derived from recommended monitoring programs. Sufficient flexibility in the physical capability of resources and engineering will allow reduction of adverse effects, once monitoring has indicate their occurrence.

14.4.1 Beneficial Effects

Beneficial effects of the recommended plans generally involve the improvement of Medan's urban environment, of the urban services to the low income residents of Medan, and of the public health of more than 1.9 million people by the year 2000. Since the plans would be implemented in an integrated fashion, many projects will have related effects and should reinforce the improvement of the low income population's standard of living. Other income groups will also benefit directly and indirectly, but benefits to these groups, although important, are not the major objective of the recommended projects.

Beneficial effects of each plan have been discussed in each section of this report and are summarized below :

- Urban Plan
  - Maintain greenbelts and agriculture open space
  - Protect approaches to Polonia Airport from urban encroachment
  - Protect the Belawan River watershed above Sunggal Water Plant
  - Reduce the rate of increase in public costs for urban services, make maximum use of existing and planned facilities, and allow development where natural advantages are greatest.

- **Housing**
  - Improve 260 ha of existing low income areas by provision of water, drainage, solid waste collection and urban services.
  - Locate 125 ha of land for a new low income housing project for 40,000 residents.
  - Support existing low income improvement projects by integrating new services with ongoing projects.
- **Water Supply**
  - Meet 60 percent of projected domestic water demands by 1985 and serve more than 80 percent with safe potable water supply by 2000.
  - Reduce dependency upon shallow wells or rivers for water supply
  - Reduce need for individual building water storage systems which become contaminated.
  - Improve the condition of remaining shallow wells.
  - Reduce or eliminate need for private deep wells and surface water treatment facilities.
- **Wastewater**
  - Reduce contamination of the Deli, Babura, and Kera rivers.
  - Reduce public health hazards from contact with untreated sewage.
  - Improve visual appearance of urban rivers within Medan.
- **Drainage**
  - Reduce flooding frequency and duration in urban areas either from ponding of rainfall or from overbank inundation by rivers.
  - Reduce ponding of contaminated wastewater.
  - Reduce public health hazards due to exposure of residents to contaminated water during flooding.
  - Improve visual aesthetics of streets and general urban area.
  - Reduce water logging of roads, and structures, contamination of shallow wells and groundwater, and damages and disruption of normal urban activities.

- **Solid Wastes**
  - Reduce habitat for disease vectors and reduce public contract with refuse.
  - Reduce organic loading and septic conditions in drains and improve quality of wastewaters.
  - Improve drainage and diminish flooding by collection of debris before it enters drains.
  - Enhance general urban visual impression and waterway appearance.
  - Reduce local burning of refuse and resulting air pollutants.
  - Increase resource recovery and composting.
  - Protect general surface water and the shallow groundwater table from contamination by uncontrolled leachate discharge and runoff from disposal sites.

- **General**
  - Significant increase in employement in construction and operations.
  - Stimulate local economy in construction materials and equipment.

14.4.2 Adverse and Other Effects

14.4.2.1 Urban Plan

The urban plan represents a projection of the urban environment that will develop during the next 20 years rather than a plan as to how it should develop. Therefore the projected urban setting in the future without the plan is virtually identical to that of the "recommended" plan. Numerous projects are already underway which will establish urban growth trends, and some undesireable effects of these trends would be expensive and administratively difficult to overcome.

Adverse effects of projected growth and the plan are :

- Isolation of residential areas northeast of the proposed Toll Road
- Maintenance of services to Medan II without incorporation in the city

- Urban sprawl along Tanjung Morawa and Brastagi roads
- Need for new bridges on the Babura and Deli rivers to serve low density areas along the southerly perimeter, while new bridges are needed to replace old bridges with very high traffic volumes.
- Partial encirclement of Polonia Airport and encouragement of urban development under southwestern approach path (Pancur Batu and Medan III).

The recommended plan has incorporated the ring road and the new Toll Road which may encourage urban development producing adverse effects on other plans. Adverse effects will largely arise from increased urban runoff upstream of the city and the creation of higher flows which will exceed drainage capacity more frequently.

Urban growth in the Tuntungan-Pancur Batu-Sunggal areas will increase runoff into the Sikambing, Putih and Bekala (Babura) rivers. Although the middle to high income-low density areas along these rivers will have good drainage, the runoff will increase the frequency of flooding along the donwstream channels and at their confluences with the main stream of the Deli River.

Diversion of drainage from the areas south of the planned Ring Road and Toll Road may cause flooding upstream of their east-west aligned segments and along the drains and river channels downstream of road culverts. The roads will encourage urban expansion and higher storm runoff along the roads, while the roadways will disrupt general drainage.

14.4.2.2 Housing

Recommended housing projects will directly improve housing conditions for 140,000 people by the year 2000. The Kampung Improvement Program does not induce additional growth in the project areas. The turnover of existing owners and renters is expected to be low, although some replacements will occur. Improvements of services and living conditions will encourage vehicle traffic in and out of each area and thereby increase congestion on Singamangaraja Street.

The new low income housing project will radically change the rural plantation setting to a definite urban residential character. Similarly, surrounding areas will be stimulated to convert to urban uses. Growth of more than 5.000 families in the southwestern-Brastagi Road sector will greatly increase traffic loading at the new ring road intersection and at the three major access points of western traffic to the central and eastern employment areas. Two existing congested bridge crossings will be further congested by increased traffic to housing site, or the ring road will carry traffic to the congested Singamangaraja Street.

Development of the Brastagi Road housing and the associated urban development will increase runoff to the Bekala River and ultimately of the Deli River. With an average annual rainfall of about 2.0 m, 90 percent development will annually contribute 2,250,000 m^3 of runoff to the Bekala-Babura basins, or about 11,000 m^3/d during the high rainfall months. This runoff and runoff from surrounding developments will increase flooding (marginally) in the Bekala and downstream reaches of the Babura River.

Dry weather flows from the housing area may include percolation of septic tank effluents or treated discharges from a wastewater lagoon sanitary system which would contaminate the Babura River. These flows may have better quality than typical urban drainage, but with flows from less controlled developments, the quality of dry weather flows in the Bekala and Babura could be degraded. Although no municipal water supply is now taken from the Babura River, future water resources development may require diversion of low, dry weather flows from the Babura to the Deli Tua Plant. The urban plan recommended constraining urban development above the Sunggal Water Plant, and new water intakes on the Deli or Percut are recommended to be above urban development (at the Deli Tua Plant this requires 6.0 km of additional pipeline). Therefore, the increased urban drainage from project and urban expansion along the Babura watershed will require additional treatment of the Babura River water for municipal water supply.

The significance of this effect is somewhat lessened by the unknown safe yield of the river and the high costs (low development potential) for use of this source with the Deli Tua Plant. If water quality of the Bekala-Babura is further degraded, the additional costs of water source development above the housing project and urban development may be too high or production losses too great for diversion of the Babura subbasins to remain a feasible municipal source.

14.4.2.3 Water Supply

The recommended water supply projects will have construction and operational effects, and these will be of different types and durations. Construction effects of water supply projects will be similar to those of sewer construction and of construction of the sewage and solid waste treatment/disposal facilities.

Construction of Source Facilities: Expansion of the Sunggal Water Plant and construction of deep well facilities will not significantly alter existing or planned land uses or cause disturbances to surrounding areas. The Sunggal expansion will occur at the existing isolated site and on a parcel designated for this expansion. Truck haulage of equipment and construction materials will add to congestion and will further damage the Sunggal Road. Increased equipment haulage, may be compensated for by use of local aggregate production for the project and corresponding reduction of aggregate hauling into Medan.

Continued use of the springs at Sibolangit will eventually require replacement and renovation of the existing pipelines probably with larger diameter pipes. Such construction will lie along existing pipeline routes and should have few adverse effects. Good construction management should be employed to reduce the soil erosion and runoff to the Deli River; slopes should be replanted, and removal of trees should be avoided.

Construction of each deep water well will have effects similar to the construction of a large single family residence. Widely scattered well sites will be selected based upon compatible or

beneficial land uses, and construction should have little adverse effects. During drilling, work schedules may be adjusted to minimise night-time disturbance to adjacent residences.

Construction of a new plant on the Deli River will produce the most significant construction effects for water source projects. Potential sites are located near Deli Tua and south of the Medan urban area. The sites consist of agricultural lands which have been cleared of most natural and bankside vegetation. Construction of the water level control weir and diversion structure will increase local water turbidity and generally disturb the shoreline along about 100 m of the river. Bankside and terrace excavations have the highest potential for encountering archeological and historic remains. Aggregate will be imported from nearby quarries, but trucks will bring other construction materials and equipment to the site along the two roads to the town of Deli Tua and then the single road to the plant site. As at the Sunggal Plant, diversion of aggregate to the plant construction will reduce truck trips on the main roads, while plant construction will generate an equal or greater number of trips; therefore net traffic on the Deli Tua Road will increase by only a percentage of the total number of trips to the plant site. Congestion and road damage along the Deli Tua Road and in Deli Tua will be increased.

Pipeline Construction: Pipeline construction will cause discruption of traffic and normal urban activity along the pipeline route for at least three months. Major adverse effects largely relate to the following factors :

a. narrow streets and rights-of-way
b. numerous pipelines already in place
c. deep ditches along each side of the roadways
d. high traffic loading and poorly controlled traffic movement
e. long distances between major intersection and few alternative routings
f. predominately hand labor, short-working hours, and poorly coordinated opening-closing of trenches and pavement repair,
g. on-site storage of trench debris, pipe, equipment, aggregate, and fill materials.

These factors will be compounded by the magnitude of pipeline construction : 290 km of major pipelines and quadrupling of street-building pipelines. Although only about half of the major pipelines will be in the existing urban area with congested streets, these 150 km of pipeline will be installed at the same time as 26 km of major sewers and about 100 km of street sewers in the central business distric (east of the Deli River). Simultaneous pipeline construction for water mains and sewers will have a significant adverse effect upon the intense urban environment of the eastern district. During the first five year period, more than 100 km of water pipe and 40 km of sewers will be installed in the eastern dense urban sector.

Few other adverse effects arise from pipeline construction in urban areas. One potential adverse effect may occur from disruption or damage to archeologically significant remains buried along the rivers. Pipeline construction requires trench excavation to at least 1.3 m depth and up to 4.0 m depth for some sewers and associated facilities. Such excavation will reach well below existing disturbed soils and may encounter archeological remains. The highest potential for such remains exist along the old river channels of the Deli, Babura, Sikambing, Belawan, and Percut rivers (usually within 50-100 m of the water). Since most major roads and utility routes either cross the rivers or lie beyond the 100 m zone of the river channels, most recommended pipelines will not have high potentials for encountering significant archeological or historic remains. Recommended pipelines between Medan and Belawan will have the highest potential for encountering and damaging archeological remains. About 15 river crossings by major water and sewer pipelines will also have relatively high potential for disturbing archeological or historic remains.

Reservoirs: The water plan recommends six large new storage reservoirs, three each in western and eastern Medan. The ground level reservoirs will have little adverse effect because of their general low physical profile (less than a two storied building) and low activity (only electric motors in pump houses).. Such features will allow use of sites within residential areas.

The reservoirs on Belawan Road, near Polonia Airport, and in Medan Baru will have to be located in highly valued commercial, residential, or recreational or institutional lands. The larger reservoirs will require up to one hectare of land. Other new reservoirs will be located in more peripheral areas with lower land use values.

Mitigation of Construction Effects Mitigation of significant construction effects should focus on minimizing traffic disruption and congestion. This can be done with the following measures :

a. on-site traffic control during construction

b. multiple shifts and night shifts for construction

c. night-time delivery of equipment and material to sites in non-residential areas

d. daily closing of trenches, removal of all excavated debris, import of fill material

Archeological mitigation should include on-site archeological inspection of excavations at the Deli Tua Plant, and along pipelines at river crossing or along the Belawan Road.

Operational Effects Operational effects include possible adverse effects upon the groundwater aquifers and the surface waters below Medan. The potential adverse effects generally relate to the quantity of water extracted from the aquifers or the streams compared to the safe yields of the sources.

Adverse effects upon water sources can be avoided by adequate monitoring of the groundwater aquifers and the low flow conditions within the streams. Such monitoring will indicate the safe yield from both aquifers and surface streams.

If a decision is made to allow dewatering of the intermediate and deep aquifers or if uncontrolled private extraction continued and expanded, then some adverse environmental effects may occur. Similarly, if the surface water treatment plants are sized to greater capacity than the streams can maintain for all basin users, adverse environmental effects will occur during low flows, expected once every 10 to 20 years. These adverse effects generally involve:

Groundwater :

- infiltration of polluted water from other aquifers and decline in water quality
- increased costs of operations for higher pumping
- saline water intrusion in Belawan
- compaction and reduction of capacity of the deep aquifers, and subsidence of the land surface

Surface waters :

- reduced mixing volumes for pollutants in wastewaters
- lowered production by other users and losses of income and employment
- saline water intrusion in the lower Belawan and lower Percut Rivers

Assuming that the projected water supplies are adequate, private diversion of surface waters and pumping of the aquifers should diminish. However, monitoring and allocations will have to be supported by inspection and control measures.

Water Quality Effects Indirect effects on downstream water quality will result from two aspects of increased water supply within Medan : basin transfers and wastewater discharges. Water is and will continue to be taken for water supply from the Belawan River and transported into the Deli, Babura, Kera, and Percut basins. Water quality in the Belawan River will decline with reduced flow.

During the low flows on the Deli River (200-300,000 m^3/d), 30 to 50 percent of the river flow will be withdrawn from the river at the Deli Tua Plant. This withdrawal plus Sunggal production and production from wells and springs will equal about 440,000 m^3 on an average day. Of this, 90,000 m^3/d will be collect by the recommended sewerage system. Therefore, a net volume of 300,000 m^3/d will re-enter the five major urban streams. If 75 percent returns to the Deli River near Glugur, the 225,000 m^3/d will mix with about 100,000 m^3/d of natural flow.

This will degrade the water quality of the Deli and its tributaries.

14.4.2.4 Wastewater

The recommended wastewater plan will result in significant adverse construction effects on traffic and the general urban setting which will be reinforced by simultaneous construction of water pipelines. The construction effects will extend over a 20 years period and therefore become an on-going effect.

Construction of the treatment lagoon along the Belawan Road will destroy agricultural lands and some natural wet lands. These effects are largely unavoidable.

Operational effects relate to the influence of the treatment facilities. The most apparent effect will be the odors from occasional malfunctions of the lagoon. Such odors will be blown into small residential/commercial areas in the Belawan Corridor and across the new Toll Road.

Mitigation for odor control could also include :

- a treatment site further east of the Belawan Corridor or on the west side of the Deli River
- greater aeration and backup power for lagoons in order to maintain aerobic conditions

Normal operations will discharge treated wastewater into the Deli River or smaller coastal waterways. Although the absolute level of Deli River pollution will be reduced over that expected in the year 2000 without treatment, untreated drainage flow will be about four times the treated discharges and about twice the existing flows. Therefore, discharge of even the treated wastewater to the Deli River will add an increment of organic load to a badly polluted river. Discharge to the Kera River would have a similar effect, since this stream will be more polluted than the Deli River. Direct discharge to the coastal marshes and estuaries will create freshwater conditions and cause major replacement of saline marshes by freshwater marshes. The organic load near a single discharge point may create toxic anaerobic conditions,

although more dispersed discharges could stimulate algal and invertebrate biota, possibly to the benefit of nearshore fisheries.

The only mitigation of discharge effects would be use of an offshore discharge with suitable diffusers. Shallow coastal waters would require a very long pumped discharge pipeline in order to reach depths needed for adequate diffusion.

1.4.2.5 Drainage

The recommended drainage activities will remove large quantities of debris and bank sediments from the drains and river channels in the Medan urban area. The removal and disposal of the excavated debris will temporarily disrupt the bankside land uses, increase turbidity in the rivers, create substantial increases in truck traffic loading of city streets, and require land disposal for more than five million cubic metres of debris during the next 20 years.

Debris cleaned from the drains and channels will not be suitable for land fills or structural uses. The material should be placed in sanitary land fills where surface runoff and leachate percolation will be controlled. These materials will have very high levels of pollutants, especially oils and other organic rich liquids.

In addition, the removal of debris will require truck haulage from the drains and rivers through the urban area to the recommended land fill site near Belawan. About 90 truck round/trips per working day for five years (260 d/yr) will pass through the northern urban area of Medan and along the Belawan Road. The trucks, dripping fluids, and odors will cause adverse effects for the traffic and residents along the haul routes. If appropriate sites are found closer to the city center, these effects along the haul routes would be reduced but considerable care must be used to ensure that the runoff and leachates are controlled.

The second phase of the drainage plan may include channel enlargement and protection of channel banks. This will be defined after monitoring the results of the cleaning program in improving dramage flows. The total volume of excavations may be about 4.4 million m^3 from more than 100 km of drains and river channels.

Bank excavations will destroy most vegetation along the channels and convert the existing waterways to typical urban drains, some unlined and others lined with concrete and rock walls. Loss of vegetation along river and major drains will continue to degrade the visual impression of the city, while increasing structural dominance in the city.

Bankside excavations will also have the greatest potential for encountering historic and archeologic remains in the undisturbed soils. This will be most likely along the Babura, Percut, and Deli rivers, with little probability along the artifical drains.

Disposal of excavated bank sediments will not require the degree of control that should be used in disposal of refuse and debris in the first phase, but the anticipated volume indicates potential adverse effects may arise from its disposal. Along small drains many local residents may desire the excavated soil in order to improve local grades, or the amount of sediment may be small enough to spread along the adjacent banks with little adverse effects. However, along major drains and river channels, the excavated sediment will probably exceed the requirements of local residents. Truck haulage of one half of the excavated materials (two million cubic metres) would require about 100 truck trips per day for 15 years (260 d/yr). Such traffic and truck loadings of the roads will cause further congestion of and damage to roads in the Medan urban area and along the Belawan Road.

The Belawan land fill site will require inorganic cover materials to properly control sanitary conditions of the landfill. The excavated bank sediments may be a good cover for the solid waste and fill, although they may be too fine for properly engineered land-fills for structural uses. Beneficial uses of the excavated materials at the land fill site compensate for the additional truck traffic on the Belawan Road, because some cover material from other sources would have to be trucked into the land fill site under normal operation.

14.4.2.6 Solid Wastes

The recommended solid waste facilities will produce adverse effects at the very large land fill site, adjacent to truck loading facilities, and along the haul routes for over 600 daily roundtrips by 2000. Significant effects will be centered on the land fill site and the Belawan Road, while minor disruptions and distrubances will occur around the truck loading facilities.

Construction of the solid waste landfill at the recommended Belawan site will alter the drainage in the coastal zone, and destroy large amounts of marshlands. The construction will require enclosure and draining of marshes as each cell becomes filled with solid waste.

Drainage changes and discharge of runoff and leachates from the landfill will adversely affect surrounding marshes, not directly destroyed by the landfill construction. Some degradation of coastal water quality will probably occur either due to leachate migration from the land fill or from changes in drainage and storm runoff.

Operating effects of the landfill will include some visual degradation of the access roads and Belawan Road from debris falling from trucks from dust and exhaust of the trucks, and from the large number of trucks travelling along the road. Truck traffic for solid waste desposal will be added to that for disposal of drainage debris and for haulage of contruction materials and equipment to other planned housing and utility developments.

14.4.3 Overall Effects

As indicated in each of the above sections, recommended facilities and operations will create beneficial and adverse effects.

Adverse traffic effects of each plan will be aggravated by truck hauling of other plans. Combined traffic effects will be most adverse in the eastern commercial area and to the north. Sewer and water pipe installation and cleaning of street drains will interfere with traffic; already congested traffic will be increased by trucks carrying the solid wastes and the drain and channel debris and by trucks carrying construction materials and equipment to and from the Port of Belawan.

The planned Belawan Toll Road and western Ring Road can reduce some local traffic load, but the wide spacing of Medan interchanges and long distance from the city to the eastern interchanges will inhibit the use of this road..

Heavy truck traffic has badly damaged many Medan roads. Expanded truck haulage for solid waste, excavated drainage materials, excavated and back fill materials for water pipelines and sewers, and construction materials and equipment will increase damage to the city's roads. Such damage will be further aggravated by pipeline excavations and enlargements of road culverts. Reduction of the compounded effects of street excavations and damage from heavy truck traffic will require extensive, coordination with road resurfacing programs and the construction of new roads (the Toll Road and the Ring Road).

Coordination of pipeline construction and routing should avoid placing several large water pipelines adjacent to local distribution water mains and large sewers. Leakage from one pipe may damage the beds of other pipelines and damage other pipelines. Parallel laying of numerous pipelines along narrow roads will increase the danger of damaging adjacent pipelines during new excavation. Most streets have very small rights-of-way and numerous excavations along the some streets will prolong and accentuate adverse effects for adjacent residents.

14.4.4 Energy

All major utility projects require large quantities of energy during construction and operations. However, the general worldwide concern for energy conservation, for potential reduction of available petroleum in Indonesia, and for substantial cost increases emphasizes the need for further consideration of this aspect.

The plan includes expansion of residential areas into areas which cannot be served adequately by urban rail transit and does not promote expansion along potential urban rail transit routes. Such trends reduce the effectiveness of more energy-efficient urban transit. The recommended urban plan concentrates more residential areas and increases residential density upto 300 to 400 persons per hectare. This density or even higher density (e.g. 500 to 700 persons/ha) would reduce distribution costs and would allow better transit and utility service.