Environmental Impact Assessment

Gwachon New Town Development Project

UNITED NATIONS ENVIRONMENT PROGRAMME

ENVIRONMENTAL IMPACT ASSESSMENT OF A NEW TOWN DEVELOPMENT PROJECT

: THE CASE OF GWACHON NEW TOWN REPUBLIC OF KOREA

by

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FOREWORD

In response to the problems of the deterioration of the environmental quality associated with rapid industrialization and urbanization during the last two decades, the Korean Government has taken legal and administrative actions to meet the challenge of environmental pollution. A major step to cope efficiently with the rising environmental pollution problems was made with the promulgation of the Environmental Preservation Law in 1977 which replaced the former Public Nuisance Prevention Law and the subsequent establishment of the Office of Environment in 1980.

Included in intensive efforts to protect and conserve the environment, the Korean Government adopted an environmental impact assessment system which ensures that the decision-making process of related government agencies includes comprehensive environmental assessment of different development activities such as urban development, industrial site and complex development, tourism site development, energy resources development, construction of seaports and roads, water resources development and apartment site development.

Despite substantial progress in EIA in Korea, existing capabilities of evaluating and predicting environmental impacts and determining remedial measures have to be upgraded.

Based on the cooperation extended by UNEP, this study was carried out as a national case study applying the UNEP Test Model to the Gwachon New Town Development Project in the Republic of Korea.

The study is a result of an interdisciplinary approach of a research team guided by Professor Kwi-Gon Kim, Seoul National University. The research team's excellent perceptions of environmental impact assessment problems of a new town development and the role of economic appraisal of environmental protection measures shape the analytical foundations of the study. It is expected that, particularly at this

early stage of the EIA process in Korea, this study will be useful to individuals, institutions and agencies working in the field of environmental impact assessment and related areas.

Thanks are due to all who have supported this study and contributed to its success.

Joon Ik Park
Administrator
Office of Environment
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PREFACE

This research has been carried out under a special service agreement by UNEP, with the cooperation extended by the Office of Environment, Republic of Korea.

The nature of services is to prepare a case study on environmental impact assessment of the Gwachon new town development.

The broad scope of work defined by the UNEP was as follows :

i) Identify major impacts which must be taken into consideration and the proposed methodologies to integrate them into economic project appraisal.

ii) Formulate environmental impact assessment guidelines for the new town development based on the local situation. These guidelines will be submitted to the Office of Environment of the Republic of Korea and disseminated to other interested countries.

This study is a national pilot study in accordance with the recommendation of a regional symposium on the"Environmental Assessment of Development Projects" jointly organized by the Ministry of Science, Technology and Environment of the Government of Malaysia, APDC and UNEP in Kuala Lumpur from 11 to 15 January 1982.

ACKNOWLEDGMENTS

This research would not have been possible without the help and support of a number of people and organizations. The cooperation extended by UNEP, the Office of Environment and the Korea National Housing Corporation, was excellent.

I am grateful to the Korea National Housing Corporation for graciously allowing me to reprint previously published material. Professor Gerald Smart, University of London, and Professor Sang-Bok Han, Seoul National University read parts of the manuscript and contributed valuable suggestions. Finally, I would like to thank Hae-Sook Lee, who typed the final manuscript.

February 1983

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INTRODUCTION

A. Theoretical Framework And Methodology

The theoretical framework of this research effort comprises the concepts of project evaluation as they apply to the environmental impact assessment of a new town development in a developing country, and the development of an environmental impact assessment methodology for new town development projects applied to the case study of Gwachon new town, Republic of Korea.

The initial step in this research effort was to undertake a comprehensive literature search of existing evaluation techniques of a single project or a number of alternative projects with applicability to new town developments. The result of this effort was negative, providing only goal-or end-means models of new town developments without interrelation of the components and elements of urbanization impacts of the new town into an extended cost-benefit analysis which would establish their interdependency.

Cost-benefit analysis is considered as a tool aimed at aiding the decision-making process. As can be seen in Figure 1, an adaptation of the cost-benefit analysis has been used to show and explain the complex relationships of environmental and socio-economic impacts associated with Gwachon new town development actions.

This approach is selected because

> "The Cost-Benefit Analysis deals with those effects that are readily quantifiable in money terms and hence which can be inserted on a cost benefit balance sheet. CBA also looks at effects that can be treated by the discounting rates. But some environmental effects are not readily quantifiable in money terms and cannot be treated by the same discounting rates as most conventional economic costs and benefits". 1/

1) Turner, R.K. and O'riordan, To., Project Evaluation in Haynes, R. (ed.), Environmental Science Methods, Chapman and Hall, London. New York, 1982, PP. 372-397.

The extended CBA suggested here may permit incorporation of the CBA tool into EIA techniques. To the extent that the two techniques are regarded as complementary, it can be a valuable aid to policy analysis and policy makers since the clear understanding of the nature of the actions and reactions of a certain measure requires the use of such environmental management tools as environmental impact assessments which should be considered as a prerequisite for the effective application of CBA.

The developed extended cost benefit analysis model for the new town has been applied to a case study of the Republic of Korea to show the application of the model with the necessary specific modifications and considerations for applying it to specific countries.

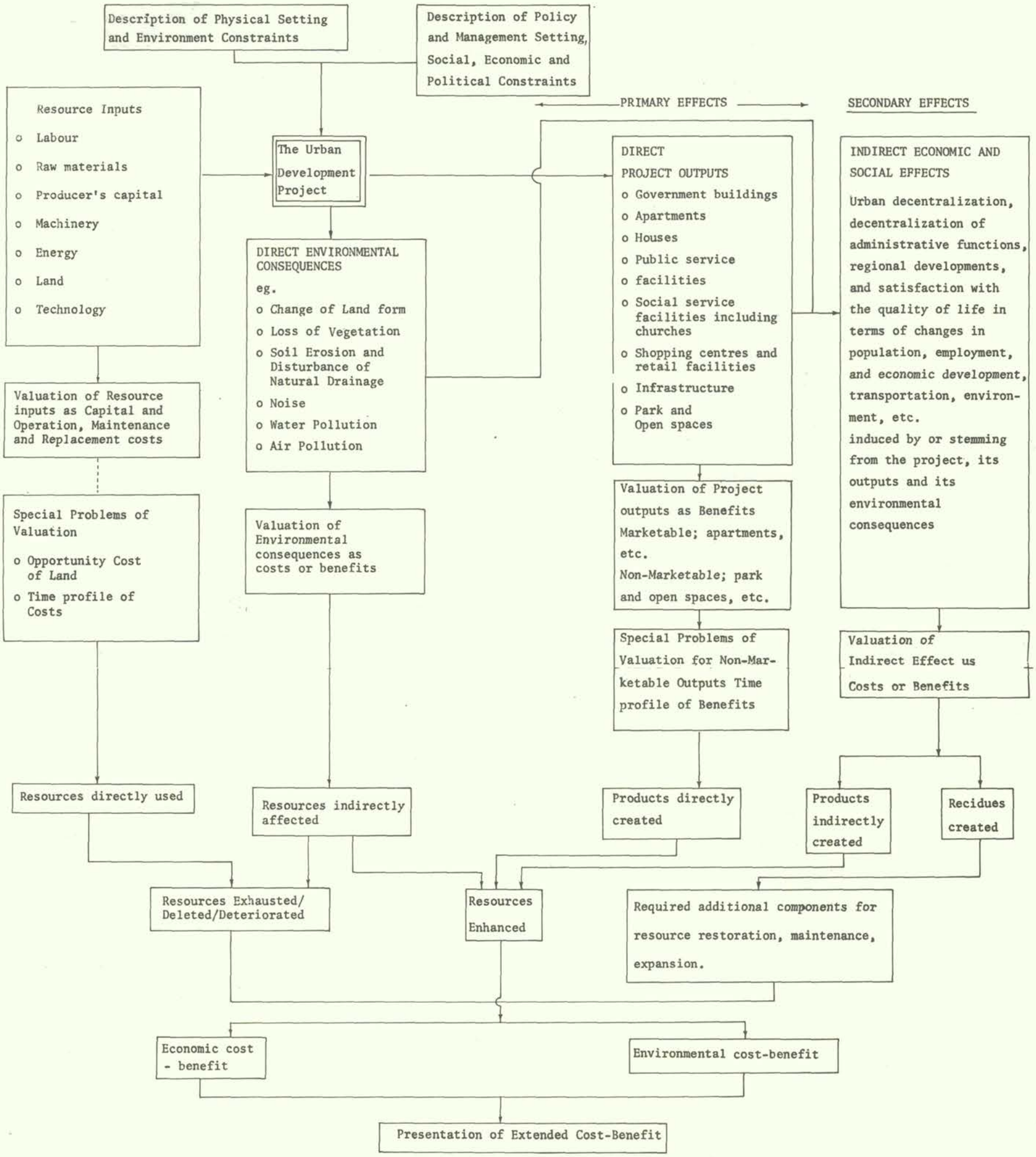


Figure 1. Schematic for an Urbanization Impact Assessment Project.

B. Selection of Assessment Criteria

The important aspect of the extended CBA procedure was to select some criteria in order to determine the desirability of the Gwachon new town project, and it is on the basis of this criterion that the assessor must be able to judge what is and what is not a relevant project cost or benefit. In principle, the criteria were divided into :

i) The environmental quality criterion.
ii) The economic efficiency criterion.
iii) The regional development criterion.
iv) The equity criterion.
v) The sociopolitical feasibility criterion.

C. Organization of the Study

This study is organized into seven Chapters. Following the introduction presented in this Chapter, the case study of Gwachon new town is presented in Chapters II, III & IV. In Chapter V the traditional impact assessment methodologies and an adaptation of the Cost-Benefit Analysis are employed to integrate major impacts with economic project appraisal.

The study is concluded with the evaluation of effectiveness of methodologies employed.

The environmental impact assessment guidelines for new town developments and survey results conducted by the author are presented in appendices.

Chapter Ⅱ.

PROJECT DESCRIPTION

A. Background of the Project

Regionally, Gwachon is situated in the southern portion of the Seoul Metropolitan area, about 15 Km from the civic centre of Seoul and 8 Km from Anyang. The proposed project site consists of Moonwon-Ri and Gwanmoon-Ri areas of Gwachon-Myon, Siheung County, Kyonggi Province. In terms of city planning, it is within the Seoul City Planning District.

Figure 2 shows the regional setting of the proposed new town site.

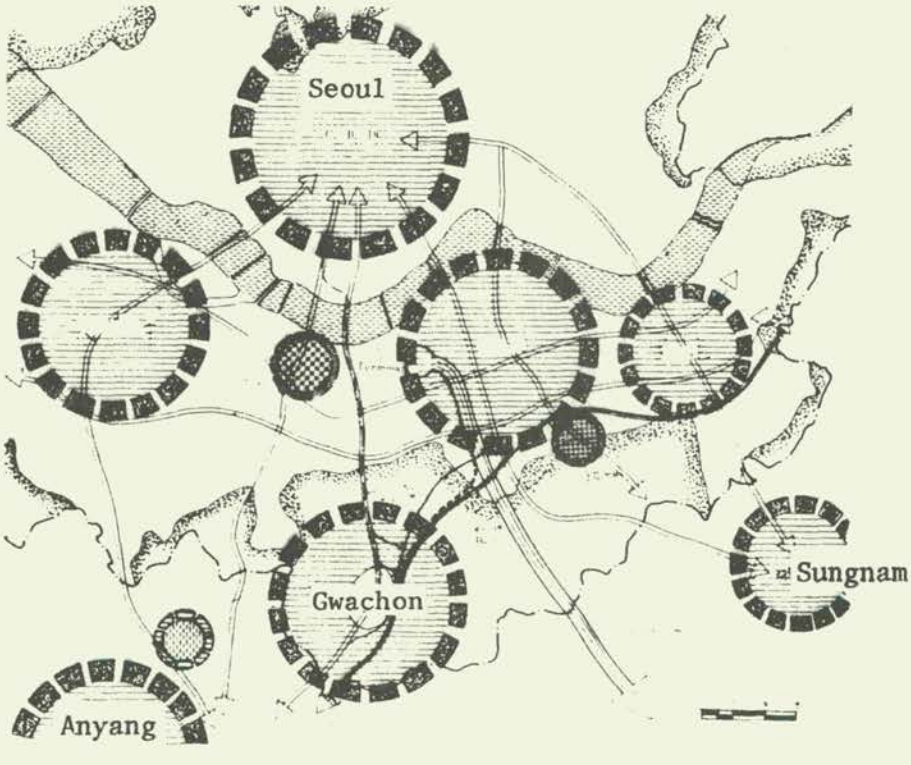


Figure 2. Regional Setting

Planning for Gwachon began late in 1978 as part of idealized new town programmes by the Korean Government based on the careful investigations of high level plans (Seoul City Plan, Reallocation Plan of the Capital Region Population), the proposed 2nd Government Hall and Seoul Grand Park site which were the central motivating force in Gwachon's

evolution.

Many of the planners are hoping that Gwachon will become a model for a new town around the nation and overseas.

In Korea, the 1977 Environmental Preservation Law,[1/] operative on 1 July 1978, provides that the concerned government agency includes an Environmental Impact Statement(EIS) in any new town development proposal likely to have significant environmental impacts. For the case of Gwachon, however, the proponent has not been requested to prepare an EIS because the project had been fully planned before the Office of Environment guidelines for the preparation of an EIS were finalized. Although environmental protection measures became an integral part of the basic new town design, the associated environmental costs and benefits are not fully internalized.

Important criteria for selecting Gwachon new town for the case study are the following :

i) The area in which the new town is to be sited is located within Seoul's green belt. The project would thus have a significant impact on the environment so that an important environmental quality problem is involved.

ii) The project would involve types of environmental effects that allow the application of extended urban benefit-cost techniques so that the usefulness of the Test Model can be examined.

iii) The project has been fully planned and is still under development. Accordingly, there are good pre-development documentations including data on actual development costs and benefits and actual environmental effects of the project. Consequently, environmental impacts can be valuated by looking at environmental settings before and after the development as costs or benefits with relatively enough precision to provide for a transparent demonstration of the methodology suggested in

1/ The Office of Environment(OOE) established on 1 January 1980 is the implementing agency for the Environmental Preservation Law.

this study.

B. Overview of the Project

The Gwachon new town development was started in 1978. During the period from 1978 to the end of 1983, approximately 2,960,000 m^2 will be developed to accommodate 63,000 residents and to house the 2nd Government Hall in the town. It is a phasing-in project like Reston, Virginia, U.S.A.

Figure 3 shows the Gwachon new town site before development. Figure 4 is a bird's eye view of the Gwachon new town development plan showing the overall project characteristics. The following photographs (Figures 5 & 6) present views of the new town development in progress.

It was very important to determine the spatial structure of Gwachon new town in preparing the general plan. In light of the important nature of this master development plan, Advisory Committee meetings were held 19 times prior to adopting the final proposal. Especially, this final proposal was completed by considering the land use and transportation system, spatial development and landscaping on the premise of the limited urban development within the green belt.

According to the construction plan of the 2nd Government hall for dispersing administrative functions agglomerated in downtown Seoul and overcrowded population in Seoul, Gwachon will be developed as an administrative-supporting new town. Gwachon will perform not only the function of a bed town accommodating administrative facilities and population to be dispersed, but also play recreation-supporting roles through balanced spatial development and the construction of Seoul Grand Park to increase leisure activities.

The goals of the new town design include a smooth transportation system, supply of high quality housing, sufficient living space and a comfortable urban environment.

Figure 3. Gwachon New Town Site before Development

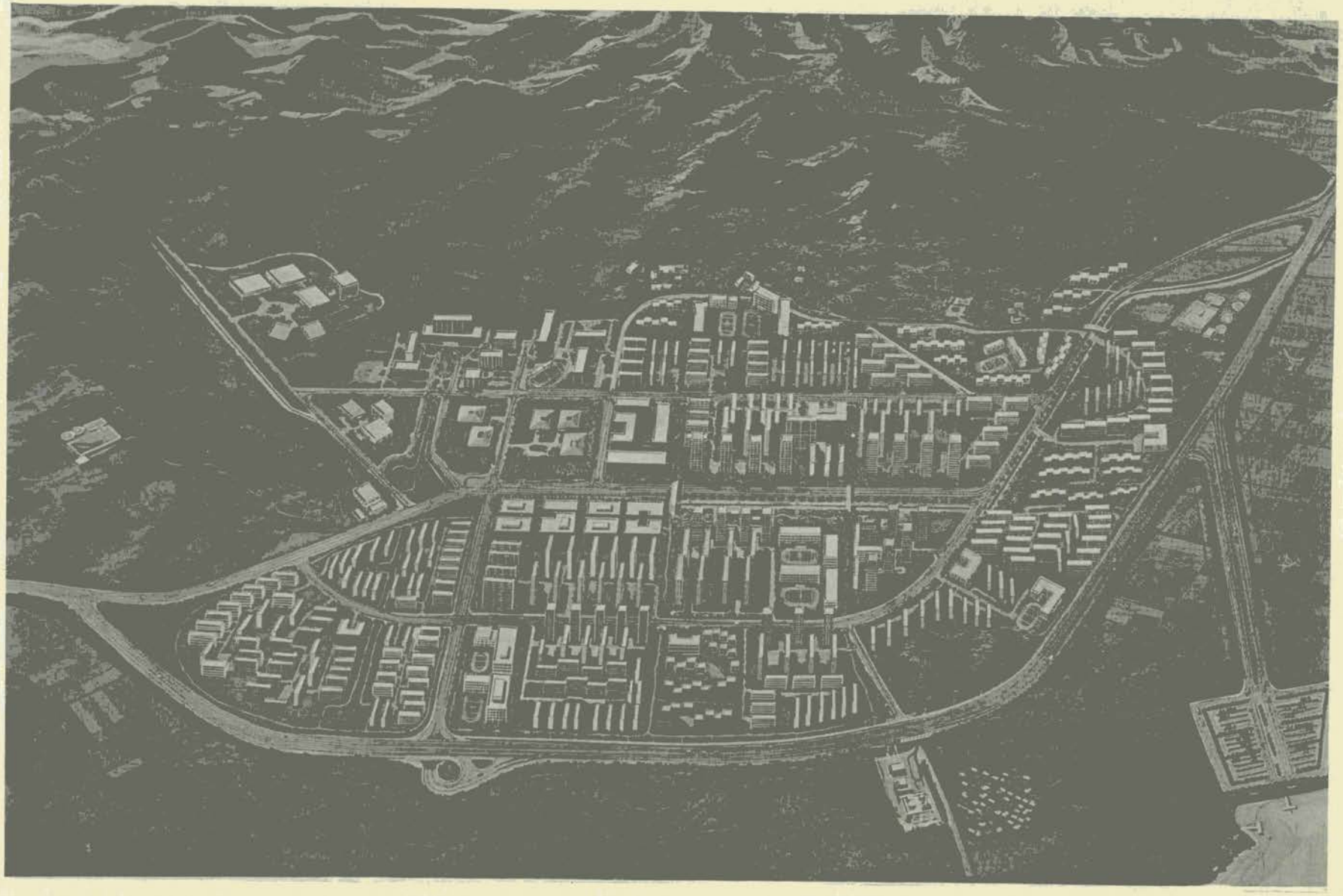


Figure 4. Bird's Eye View of the Gwachon New Town Development Plan

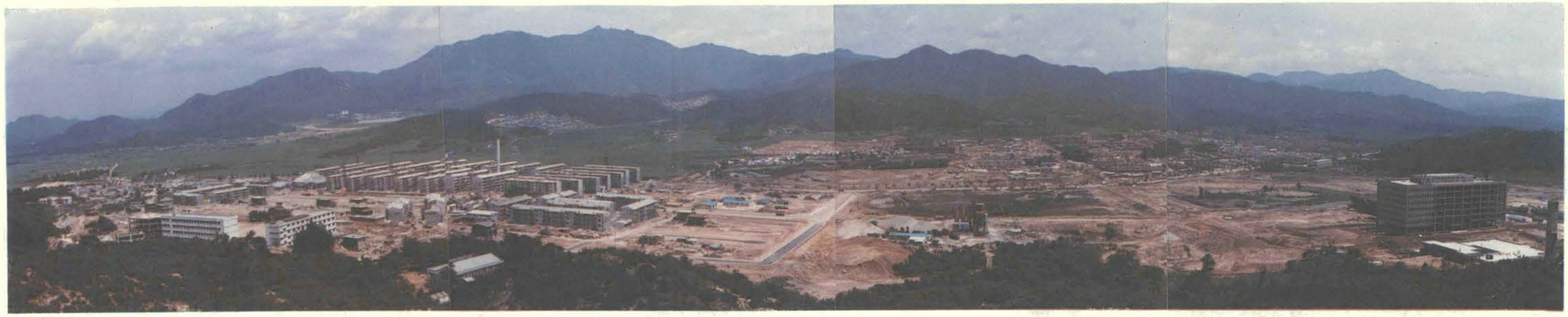


Figure 5. New Town Development Being Underway (May 1981)

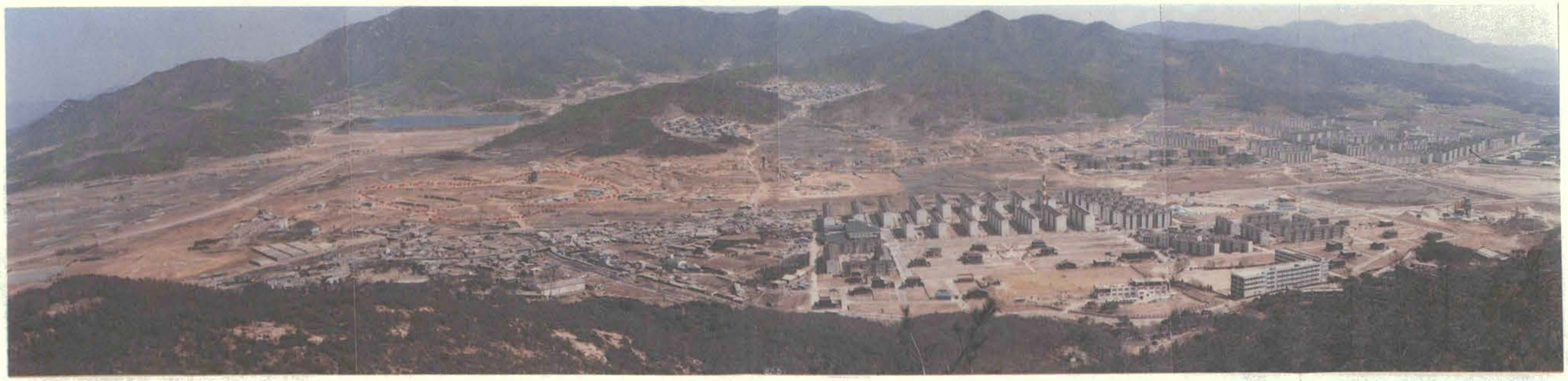


Figure 6. New Town Development Being Underway (May 1982)

The total site consisted of 2,959,040 m^2 (660,500 m^2 for the 2nd Government Hall) to house 63,000 people (14,200 dwelling units). The development will preserve approximately 541,610 m^2 or 23% of the 2,298,540 m^2 (total new town site area minus the 2nd Government Hall site area) as parks.

Table 1 shows the land use plan of the proposed new town project.

Table 1. Land Use Plan

Total	Residential	Commercial Business	School	Road	Park
(100%) 2,298,540 m^2 1/	(46%) 1,060,103 m^2	(6%) 138,704 m^2	(6%) 132,100 m^2	(19%) 426,023 m^2	(23%) 541,610 m^2

Source : Korea National Housing Corporation, January 1983.

The proposed project covers the construction of 678 single detached dwellings and 644 attached dwelling units and 12,860 apartments on the 1,060,103 m^2.

Table 2 provides a summary of the proposed housing development plan.

Table 2. Proposed Housing Development Plan.

	Total	Types of Housing			Remarks
		Detached	Attached	Apartment	
Total	14,200	696	644	12,860	Apartment 5 storeys : 9,550 dwelling units. 14 & 15 storeys : 3,310 dwelling units. Solar-heated Houses : 18 units.
Stage 1st	1,290 2/	228	204	840	
Stage 2nd	6,075	235	-	5,840	
Stage 3rd	5,537	233	264	5,040	
Stage 4th	1,316	-	176	1,140	

1/ This figure does not include the 2nd Government Hall site and consists of 77.7 % of total areas.

2/ This figure includes 18 solar-heated houses.

Table 3 relates the proposed land use types to the actions on the environment allowing to deduce categories of operationally useful environmental alterations from land use types. Interrelations produced here have been identified on the basis of field observations, the master plan, and the various progress reports for the new town development in Gwachon.

Table 3. Interrelations of Land Use Types and Actions on the Environment

DIRECT ACTION / LAND USE TYPES / ACTIONS ON THE ENVIRONMENT		Village Clearing	Vegetation Clearing	Excavation, Cutting	Earth Moving, Filling	Stream Channel Improvement	Building	Paving	Landscape Planting	Fencing (or Hedge)
Residential	Intensive (High Density) Housing	●	●	●	●	●	●	●	●	●
	Medium Density Housing	●	●	●	●	●	●	●	●	●
	Low Density Housing	●	●	●	●		●	●	●	●
Commercial, business	The 2nd Government Hall	●	●	●	●	●	●	●	●	
	Neighbour-hood Centre	●	●	●	●		●	●	●	
	Community Centre (C.B.D.)	●	●	●	●	●	●	●	●	
Schools		●	●	●	●		●	●	●	●
Parks	Play-grounds	●	●	●	●			●	●	●
	Neighbour-hood Park	●					●	●	●	●
	Town Park	●		●	●	●	●	●	●	●
Roads		●	●	●	●			●	●	

Chapter Ⅲ.

GENERAL DESCRIPTION OF ENVIRONMENTAL SETTING

A. Overview of the Environmental Setting

Geographically, Gwachon is situated in the southern portion of the Seoul Metropolitan area, about 15km from the civic centre of Seoul. It is 8km away nothern from Anyang which is a small industrial and recreational town. In terms of urban planning, it is within the Seoul Metropolitan area. There were rural villages on the new town site itself and are rural villages in the site-adjacent areas. Figure 7 shows the pattern of rural villages before the new town development.

Local traffic service to the site is provided by a through-traffic road(Kyonggi Provincial road 395, four lanes 15m) which connects Seoul (Sadang-Dong) with Anyang (see Figure 7). Figure 8 presents a typical new town site cross section which shaped Gwachon's landscape character.

According to present construction and sales projections, the development should be completed and fully occupied by 1984.

Gwachon is part of the metropolitan air shed and part of the watershed of the Han river basin. The area is characterized by a continental climate which shows temperature extremes. Predominant wind directions are WNW in Winter and ENE in summer, with annual average wind speeds of 2.5 m/sec. Topographically, the area is surrounded by mountains to the north (Mt. Kwanak, 630 m) and to the south (Mt. Chyongge, 650m).

B. Inclusion and Exclusion of Specific Factors for Consideration in Assessing the Impacts

Any respectable EIA must start from an understanding of the physical and natural processes and parameters which are likely to be properly evaluated. However, all the relevant impacts connected with the new town project can not be identified. It may not be necessary to list all of them in the factor approach. It is useful to determine inclusion and exclusion of specific factors for consideration in assessing the impacts of the proposed project.

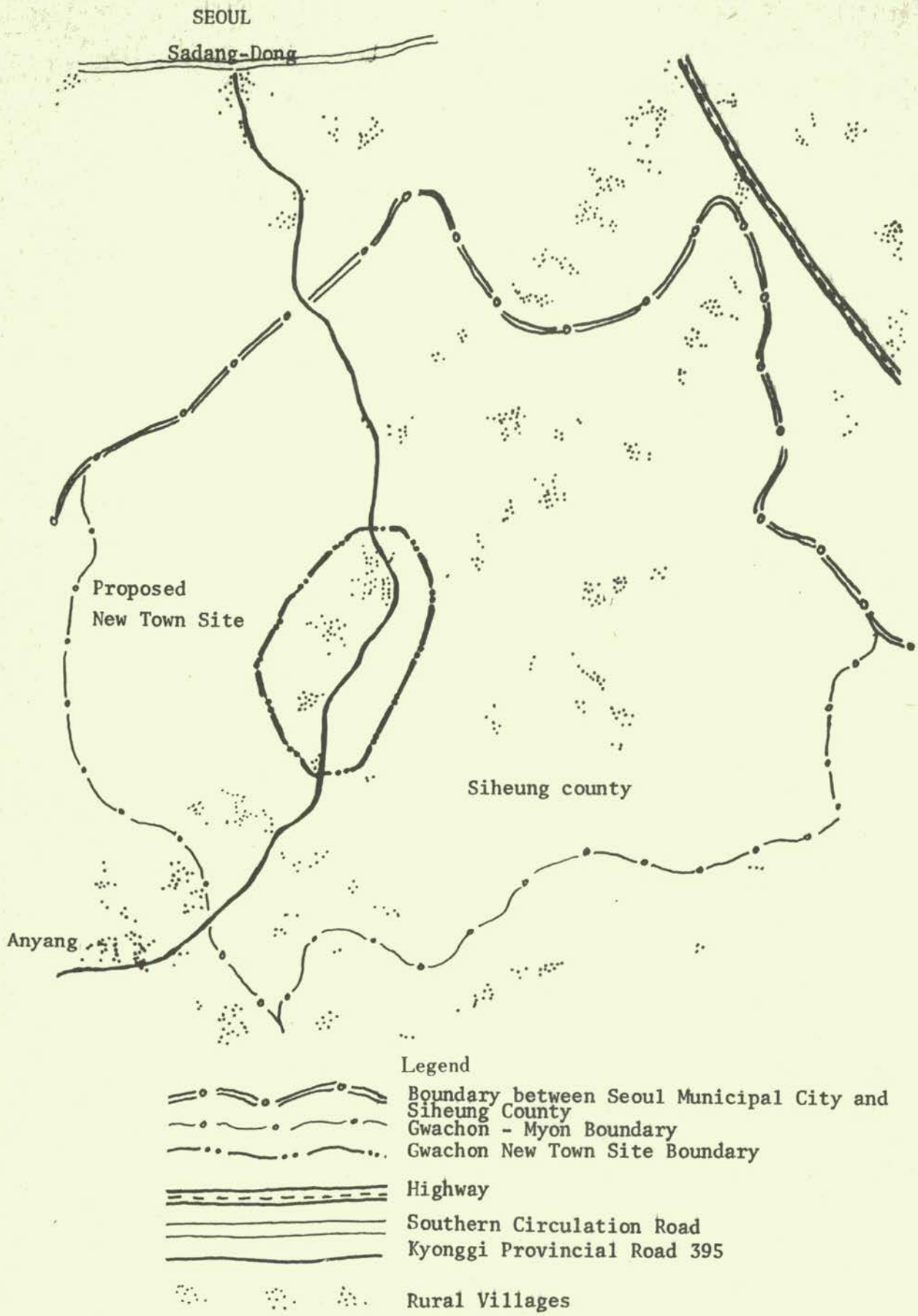
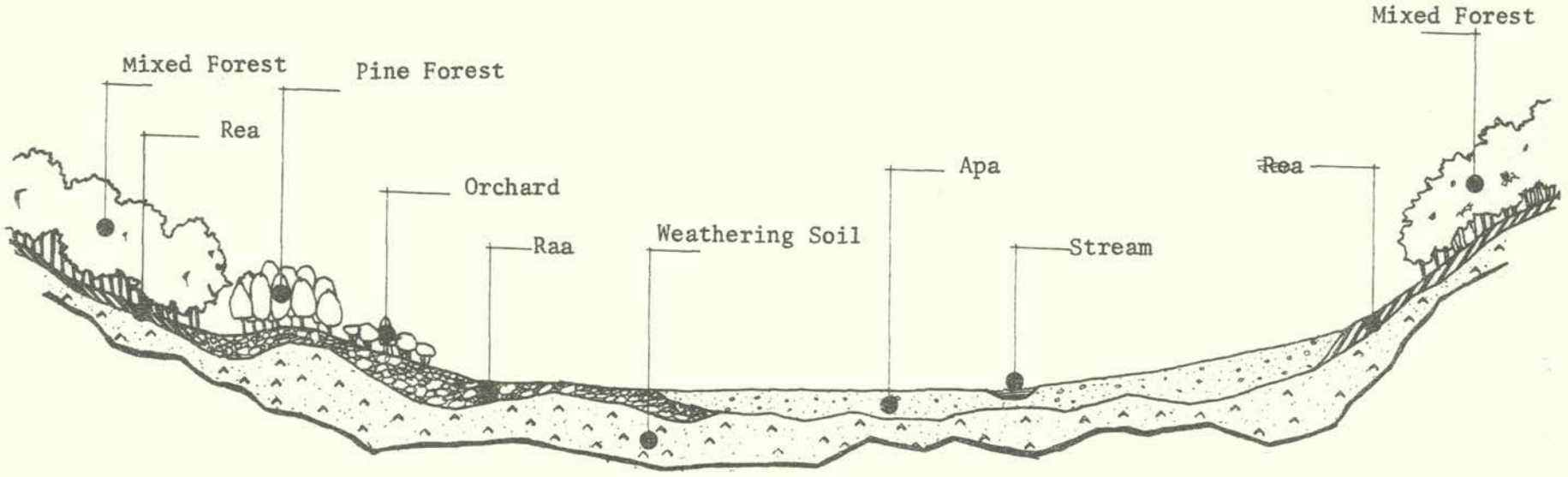


Figure 7. Pattern of Rural Villages before the New Town Development



Legend

Rea : Low hill, well-drained, erosive, clay-loam & sand.
Raa : Low hill, well-drained, clayey & clay-loam.
Apa : Alluvium fan, poorly-drained, silt loam and clayey.

Figure 8. A Typical New Town Site Cross-Section

Informal personal interviewing about how people judge the seriousness of likely effects were conducted. Finally, the relative merits of different arguments advanced by different interests were weighed up as follows :

Table 4. Composite Summary of Judgment

Environmental Factor/Constraints	Relative Significance 1/ of Impacts
Topography	Slight
Soils	Slight
Hydrology	Slight
Climate and Meteorology	Insignificant
Vegetation, Animal & Habitat	Insignificant
Existing Villages, Families and Businesses	High
Land Use	High
Archeology	Insignificant
Demography	Slight/High
Utility Services	Slight
Municipal Services	Insignificant
Transportation, Traffic and Parking	High
Air Quality	High
Noise	High
Visual/Aesthetics	High
Community Identity	High
Sociability-Friendliness	High
Regional Development	Slight/High
Self-containment	High
Social Balance	High

1/ "High" indicates the 1st order priority, "Slight" the 2nd order priority and "Insignificant" the 3rd order priority in selecting critical impacts of the new town project.

According to the composite summary of judgement, people placed "high significance" on many economic and social environmental factors.

Chapter Ⅳ.

ENVIRONMENTAL IMPACT ANALYSIS

In this chapter the environmental setting of each factor is described to provide base-line data against which prediction and assessment of the impacts of the proposed action can be compared. It includes recommendations on how to reduce or remove the most serious of the impacts as measured and as socially valued. A programme of inspection both during project construction and after project completion to ensure that environmental effects are minimized is developed.

A merit of this chapter would be to identifying of how development efforts are valued by representative sections of Gwachon. We believe that any fairly sophisticated analysis involving scientific judgement and expertise of various kinds is likely to lead to conclusions that could be usually in favour of the project and easily prove irrelevant to the interests of the community involved and to wider interests. In practice we used sampling methods to simplify and shorten the social survey. It is discussed in greater detail in appendices of this report.

A. Natural/Physical Factors

1. Topography

a. Environmental Setting

The area proposed for development lies in the valley passing through between Gwanak Natural Park and Chyongge Natural Park. It has a parkland setting.

Generally, the topography of the site ranges in elevation between 40 and 125M above sea level. Some 60M above sea level are to remain in open space to be preserved as forest. The slopes in the area proposed for development are moderately steep ranging primarily from 0 to 20 percent.

Surface earth material within the area consists of gneiss and schist. Soils consist of materials containing varying amounts of clay, silt, sand and gravel with some organic matter. Some soils are well-drained and others poorly-drained (See Figure 8).

b. Impact Assessment

The proposed development would moderately alter the existing terrain of the site. The estimated depth of the highest cut and fill slopes range from 4-5m in vertical height (Figure 9).

The existing slope of the land is incorporated to the extent feasible into the design. Most grading follows the traditional pattern previously used for development of the existing Apartment Complexes on the other site. The change in the orography will have significant effects on the existing local wind flow pattern.

The proposed cut and fill operation consists of lowering the northwesterly ridge crest and extensive fill placement in the southeasterly agricultural lands. Major cut slopes are proposed along the southerly edge of the tract for construction of the by-pass road. The by-pass roadway with an average slope of 2.4% would require 212,000 m^3 of cut and fill.

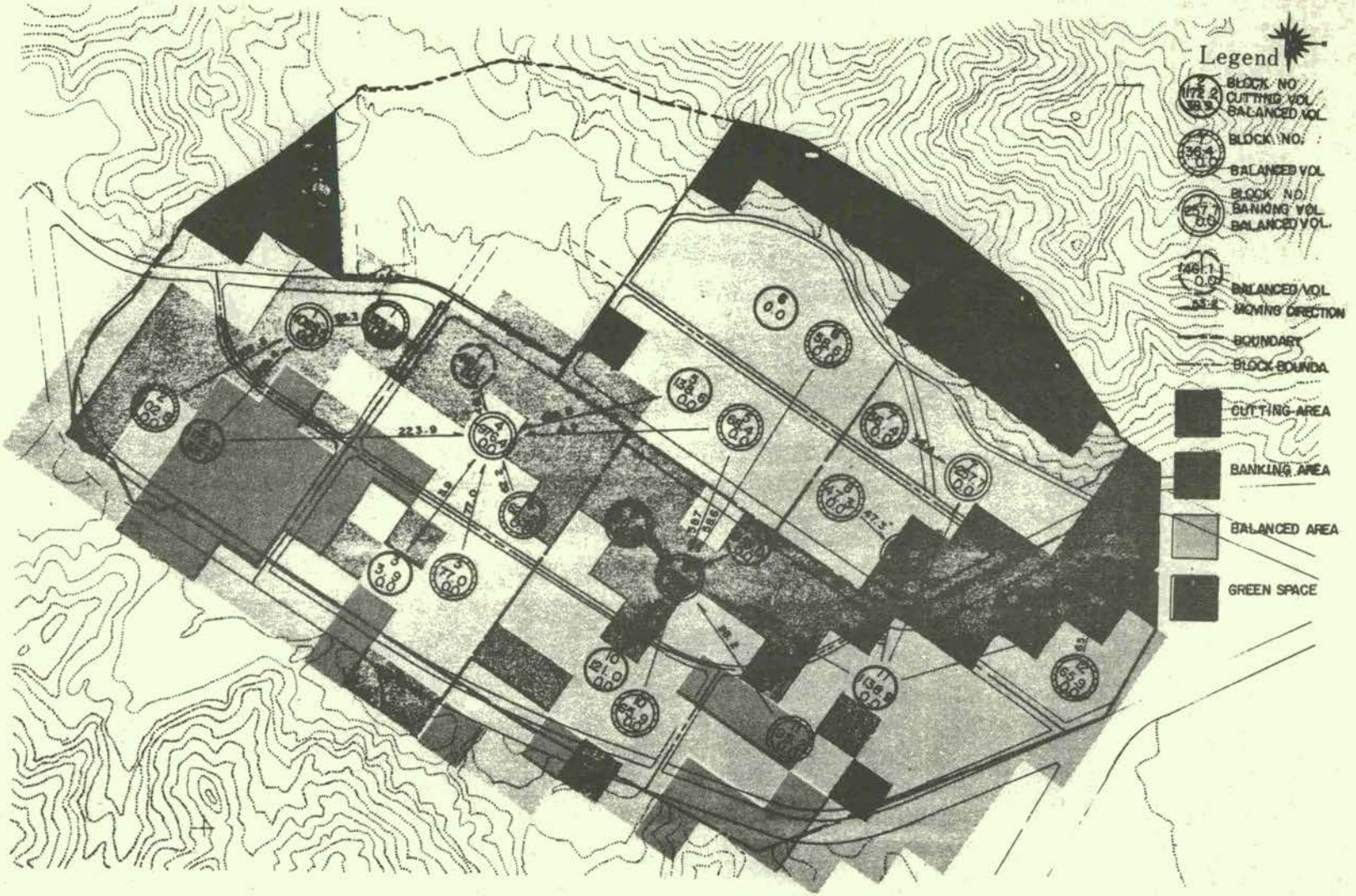


Figure 9. Soil Movement by Earthwork Design

Steep slopes would result in higher road cuts and longer fill slopes which in turn could result in greater soil areas being exposed to erosion.

A major element of the detailed design report for the construction of roads servicing Gwachon new town [1/] is the planned landscape revegetation of these graded and developed slopes.

The project engineer estimates that about 20,171.3 [2/] million m^3 of earth would be excavated, all of which would be recompacted within the project on other parts of the tracts. This operation would cost 2,473 million won. [3/]

Stage grading is being conducted to expose only those areas necessary at each phase. Grading for phases I and II has been completed and for phase III is in progress. Another aim of phasing-in grading would be to compensate displaced people for a loss of land and business leases in due course.

Construction related impacts would result in removal of the existing soil mantle in road and other access and building areas being developed, about 504,400 m^3 of the natural fertile top soil would be sacrified due to the proposed cut and fill operation unless proper mitigation measures are taken. 174,444 thousand won (only for stages I, II and III) would be required for the collection and reuse of the top soil.

1/ The Ministry of Construction and the Korea National Housing Corporation, The Detailed Design Report for the Construction of Roads Servicing Gwachon New Town, 1980, Seoul.

2/ Based on the completion of grading operation stages I, II and III

3/ One U.S. Dollar equals approximately 750 Won in Korean currency.

Proposed cut areas may expose adverse soil texture when graded. The soils would be amended with small quantities of organic matter to increase soil texture and create more conducive growing conditions. The planned landscaping program specifies the plant materials and landscaping concept for completely restructured areas, as well as natural areas which are proposed to remain as parks and open space. The restructured areas require deep rooted plants such as acacia, and bush clover (Lespedeza biocolor Turcz.) for the graded slopes.

Mud flow during construction is an adverse impact in the area. The total amount of construction-related sediment production anticipated from the cut and fill operation may be only minimal.

c. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer. 1/

- Stage grading to expose only those areas necessary at each phase

(2) Other measures that could be incorporated.

- All top soil beneath proposed cut and fill areas including building areas, road and other access to be developed should be collected and reused for landscaping with plants and other purposes unless specifically tested and approved by the Project Soil Engineer. At this proposed project site, the collection and resuse of topsoil cost 174,444,000 won for about 504,000 m^3 of natural fertile top soil.

- Remove and/or recompact all unstable soil in order to protect the existing residents at lower elevations when the by-pass roadway will be constructed.

- All fill and cut slopes subject to erosion shall be planted with deep rooted plants to protect the slopes against erosion as soon as possible.

1/ Mitigation measures which are proposed as a part of the project and fully incorporated into the project design to reduce the adverse impacts of the project.

2. Hydrology

a. Environmental Setting

A part from Yangjae Stream and its tributaries, three tributaries from Mt. Gwanak and three tributaries from Mt. Chyongge form main natural surface drainage channels in the area. The main stream flows from the south-west to the northeast and connects to Han River (Figure 10).

Recently, the surface water from Mt. Gwanak is polluted in most places. It is not clean enough for drinking water any longer.

The average number of months without flowing water in the stream passing through the planned area reaches 10 months and storm water flows only in wet months.

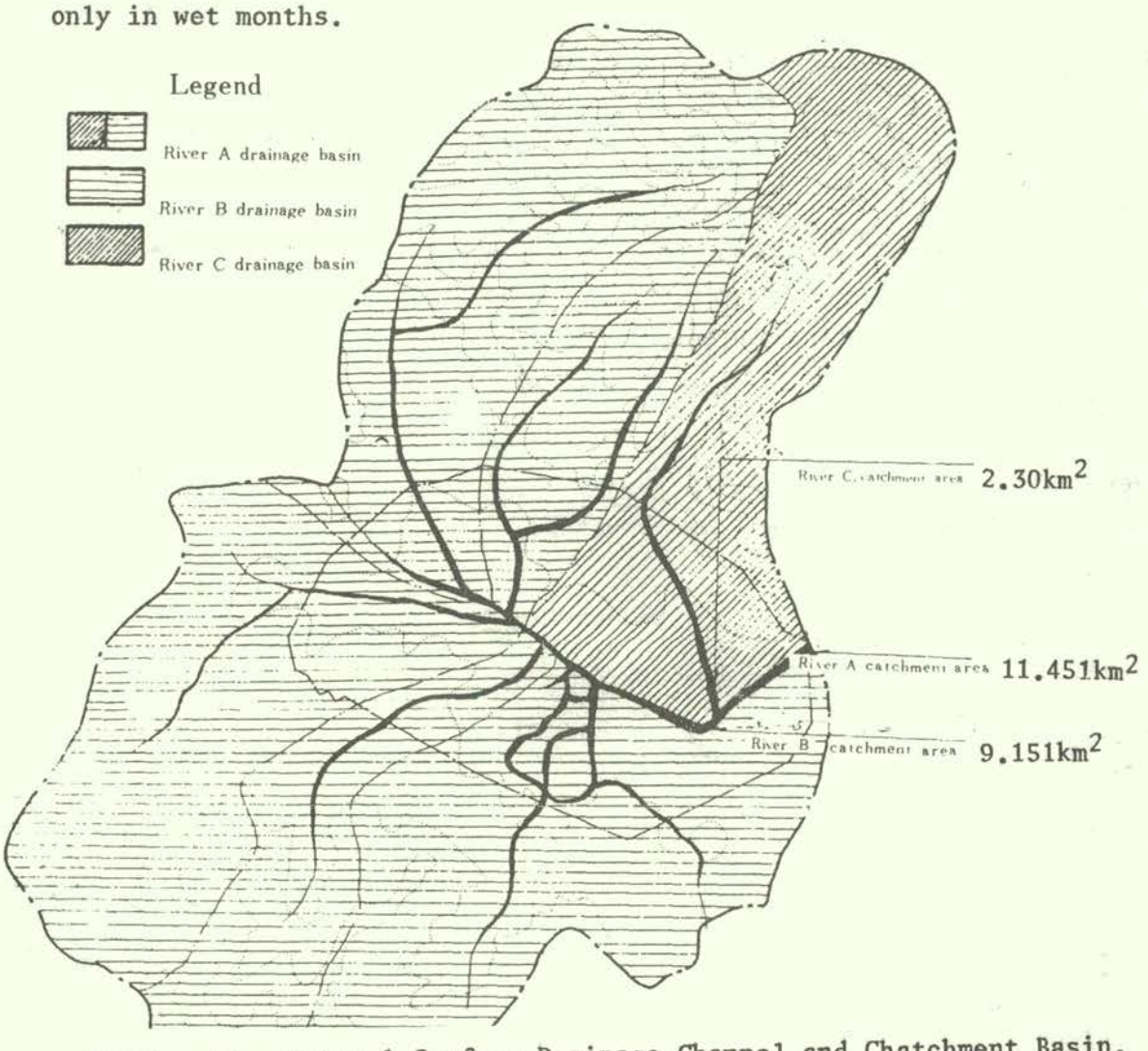


Figure 10. Natural Surface Drainage Channel and Chatchment Basin.

Generally, the soils of the site have a hydrologic soil characteristic of moderate depth, consisting chiefly of poorly to well drained soils with moderately coarse textures. In particular, the soils are poorly drained on alluvial fans of agricultural lands.

b. Environmental Impact : The proposed development would not adversely affect the natural surface drainage system of the site except for the 2nd Government Hall site. However, the underground water system of the site would be significantly affected by the installation of a utility collector. There is a potential danger of underground water seeps.

The artificial structures and asphalt pavement areas impervious to percolation of water would be increased by 80 percent of the total surface areas in the proposed project. Thus, the runoff volume of the site would be increased. According to the project engineer's estimation, the estimated storm flow associated with total development at phases I, II, III & IV is within the capacity of the main stream system under the river improvement plan.

During construction, loose and unprotected earth materials subjected to sustained or high intensity precipitation during wet months could result in siltation of down stream areas. However, the site would be less vulnerable to water erosion after completion. Four small dams which have a similar role as the siltation pond have been installed in rivers A and B (refer to Figure 10) to prevent siltation of down stream areas and reduce the stream flow velocity.

Utilizing current construction data in Gwachon, the following costs are calculated for completed dams:

Dams	Quantity	Costs
Dam Type A (L-40^{m}. B=1.8^{m}. H=0.5^{m})	2	Won 9,213,000
Dam Type B (L-30^{m}. B=2.5^{m}. H=0.5^{m})	2	5,287,000
Total	4	Won 14,500,000

Other adverse impacts will be reduced to an acceptable level.

c. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer :

- Approved perforated pipe and gravel subdrains are to be provided beneath hydrologically significant areas. The provision of them cost Won 36,993,000 for 4,964 m of sub-drains.

- Improvement of town storm drain system and Yangjae channel to increase the capacity over the estimated storm flow associated with total development. The cost for the installation of the town storm drain system is Won 2,848,300,000 and improvement cost of Yangjae channel is Won 2,803,000,000.

- Construction of four dams to prevent sedimentation, particularly during construction. It costs Won 14,500,000.

(2) Other measures that could be incorporated :

- Surface water will not be permitted to accumulate in excavations or depressions about the site.

- It is anticipated that most grading will occur during the dry months to minimize the possibility of sedimentation by erosion.

3. Climate and Meteorology

a. Environmental Setting

Though no data is available on Gwacheon, it can be assumed that the site is situated within the airshed of the greater Seoul-Incheon metropolitan area. Consequently, the climatological and meteorological setting of the site resembles that of Seoul.

Accordingly, the annual average precipitation amounts about 1400 mm. About 70% of the annual precipitation occurs during the period June to September. According to Table 5, the temperature varies from an average

Table 5. Climatological Data for Seoul

Month	Temperature (°C)			Precipitation (cm)			Average Relative Humidity (%)	Maximum Wind Velocity (m/sec)
	Average Minimum	Average	Average Maximum	Monthly Average	Daily Maximum	Evaporation		
January	-7.5	-3.6	0.7	2.25	3.91	4.13	66.1	15.7
February	-5.1	-1.2	3.3	2.71	4.90	4.86	66.7	16.7
March	-0.2	3.9	8.9	5.16	6.53	8.02	65.4	22.3
April	6.6	11.3	16.9	9.91	9.28	11.52	64.1	22.3
May	12.3	17.0	22.9	9.32	12.23	15.46	65.5	20.5
June	16.8	20.9	26.2	14.24	19.73	14.27	73.8	13.7
July	21.6	24.5	28.5	41.20	22.63	11.59	83.3	18.0
August	22.2	25.4	29.9	25.88	27.32	13.12	79.7	35.0
September	16.4	20.5	25.5	18.03	14.77	10.68	74.0	16.7
October	8.8	13.7	19.4	5.21	6.16	8.93	68.6	14.7
November	2.3	6.6	11.4	4.49	5.01	5.92	67.8	15.3
December	-4.7	-0.9	3.3	2.09	4.75	4.19	65.7	17.7

Source: Meteorological Almanac (1954 to 1975).

of -3.6°C in January to 25.4°C in August. The predominant west and northeastern wind flow observed in Seoul, however, is not transferable to Gwacheon. In fact, the main wind direction in summer is ENE while in winter it is WNW. However, it can be assumed that the comparably high frequency of inversions with low level mixing heights and calm periods as observed in Seoul can be applied to the Gwacheon new town development area. The specific topography characterized through mountains to the north and south preventing crosswind ventilation, and the high frequency of temperature inversions in conjunction with low precipitation during most of the time, gives Gwacheon a great potential for air pollution.

b. Environmental Impact

Contrasts in albedo, heat capacity, and hence heating and cooling rates, heat generation, and surface roughness between the city and its more uniform surroundings result in the generation of localized weather processes, including considerable differences in temperature and localized changes in wind flow patterns. Specifically urban areas situated in low-lying valleys meeting the characteristics of Gwacheon can create a modification of the microclimate, since many of the topoclimatological differences act in the opposite direction to those induced by the rural environment 1/.

The role of the urban heat island phenomenon in purposedly modifying the local atmosphere to produce a distinctive urban climate has to be more closely investigated. The need is emphasized to incorporate mesometeorological considerations into city planning.

Generally, however, the proposed project is not expected to significantly affect the microclimate since the size is comparably small. However, the effects on the surface wind flow pattern are relevant, yet will not result in any negative effects.

c. Mitigation Measures

Mitigation measures are not envisaged.

1/ Garstang, M. Tyson, P.D. and Emmit, G.D. The Structure of Heat Islands, Reviews of Geophysics and Space Physics, 139 (1975).

4. Air Quality

a. Environmental Setting

The specific topography characterized through mountains to the north and south preventing crosswind ventilation, and the high frequency of low level temperature inversions in conjunction with low precipitation during most of the year, gives Gwacheon a great potential for air pollution. Being part of the Seoul-Incheon metropolitan airshed causes higher background concentrations of, for example, sulphur dioxide and particulates compared to background concentrations observed in rural areas outside the airshed.

When completed the new town will consume about 23,000 kiloliters of 1.6% sulphur containing heavy oil to be combusted in 9 central heating plants and about 12,000 MT of anthracite coal burned in 3100 individual households per year. Applying suitable emission factors, the combustion of oil will result in an emission of about 625 tons of SO_2 while the emissions contributed by coal will amount to approximately 85 tons per year if no control is assumed (Table 6).

Table 6. Emissions resulting from heavy oil combustion for heating and bathing and coal combustion for heating (1985)

Unit: ton

Pollutant / Fuel	CO	HC	NO_x	Particulates	SO_2
Bunker-C	14	8	35	28	625
Anthracite Coal	192	23	11	?1/	13
Total	206	31	46	28	638

1/ No emission factors are available applicable to the typical Korean household heating system.

In addition, for cooking purposes about 4.5 million m^3 of city gas and 3.6 million m^3 of liquified natural gas (LNG) will be used per year. This will result in annual emissions of about 9.0 tons of NO_2 (Table 7).

Table 7 . Emissions resulting from city gas and LNG combustion for cooking

Unit: ton

Pollutant / Fuel	CO	CH_4	NO_x
City-gas	1.5	0.6	5.4
LNG	0.8	-	3.6
Total	2.3	0.6	9.0

Regarding road traffic, it is estimated that the annual kilometerage of gasoline-fuelled passenger cars will be about 38 million, of LPG-fuelled passenger cars about 9.5 million, of trucks about 15 million and that of buses 11 million in the new town area by 1986. Applying corresponding emission factors the following emissions resulting from road traffic can be expected by that time (Table 8).

Table 8. Emissions from road traffic (1986)[1/]

Unit: ton

Pollutants / Type of Vehicles	CO	HC	NO_x	Part.	SO_2
LPGV	70	20	45	-	-
LDGV	540	95	205	-	-
HDDV	140	38	410	25	69
Total	750	153	660	25	69

1/ These are only rough estimates since a detailed prediction of the composition of the traffic is not available.

From Tables 1 to 3, the total emissions shown in Table 9 are obtained within the new town area:

Table 9. Total Emissions (1986)

Unit: ton

Pollutant	CO	HC	NO_x	Particul.	SO_2
Amount	958	185	715	53	707

Regarding fugitive particulate emissions resulting from construction activities, unpaved roads, and uncovered soils, no reasonable figures can be given. Applying the Smeared Concentration Approximation Method (SCAM)[1/], a simplified air pollution dispersion methodology for regional analysis, the SO_2 ambient air quality levels can be estimated in the study area. The SCA method centers around short-range transport or dispersion on the urban scale for three emission classes, namely low-level area sources, medium level point sources, and high level point sources. The method includes the essentials of dispersion under different meteorological conditions, hence different local atmospheric stabilities and wind speeds. Since it is a smeared concentration approximation method, the SCA dispersion parameters are formulated for a uniform wind-rose and different average urban radii. For example, the SCA dispersion parameter D_i for the low-level emission class i is calculated by multiplying each D_{ikj} by the frequency of occurrence of different combinations of atmospheric stability j and wind speeds k and then summing the results, as shown in equation (1).

$$(1) \quad D_i(R_o) = \sum_{jk} FF_{jk} \cdot D_{ijk}(R_o) \quad (10^{-4}\ \mu g/m^3/t \text{ per unit time}),$$

where $D_{ijk}(R_o) = \exp(a_{ijk} + b_{ijk} \ln R_o)$ and a_{ijk} and b_{ijk} are empirically derived coefficients.

1/ Dennis, R.L. The Smeared Concentration Approximation Method: A Simplified Air Pollution Dispersion Methodology for Regional Analysis, International Institute for Applied Systems Analysis, 1978, A-2361 Laxenburg, Austria.

The SCA dispersion parameter is thus strongly dependent on the atmospheric stability, the wind speed, and the average urban radius R_o. Using corresponding SO_2 emission (Tables 6,8) and the meteorological parameters as given for Seoul (no suitable data for Gwacheon are available - this is therefore only a rough approximation) the resultant SO_2 ambient air quality is estimated to be 12 ppb. Based on the assumption that Gwacheon is part of the Seoul-Incheon metropolitan airshed the actual SO_2 concentration will be considerably higher.

Unfortunately, due to limited resources, no continuous ambient air quality monitoring could be carried in the study area. The only actual data available are based on the analysis of 40-liter samples that were obtained in teflon bags at two sites within the development area. The samples were subjected to analysis in the laboratory. For the measurement of TSP, a high-volume air sampler was established and operated for 3 consecutive days. The data obtained are given in Table 10.

Table 10. Air Quality Levels in Gwachon[1/]

Pollutant	Analytical Method	Site 1 (ppm)	Site 2 (ppm)
SO_2	Pulsed Fluorescence	0.023	0.022
CO	NDIR	0.8	2.0
NO	CL	0.005	0.012
NO_2	CL	0.009	0.018
Ox	UV Photometric	0.018	0.016
CH_4	FID	1.3	1.4
N-CH_4	FID	0.6	0.8
TSP	High-Volume	175 $\mu g/m^3$ (daily arithmetic mean)	

1/ 19 January 1983, 12 am; the samples were collected in 40-liter teflon bags over a period of about 10 minutes

The sites were selected to be representative for the study area. Site 1 is situated in the center of one apartment complex area while site 2 is located 30 m apart from the main road. The selection of the high volume air sampler site was dependent upon the power supply source, however, is also representative for the area.

The meteorological conditions were typical for a mid-day situation in January with a neutral atmospheric stability (m = 4), a wind speed of lower than 2.5 m/sec, a temperature of -2°C, an atmospheric pressure of 1025 mb, and clear to hazy conditions.

The concentrations obtained for gaseous pollutants do not give rise to apprehension. No comparison with ambient standards, however, can be done since the sampling time is too small to be comparable to corresponding averaging times of ambient air quality standards. Moreover, from a statistical point of view the data is biased. However, it is interesting to note that the SO_2 concentration at both sites is within the range of the predicted SO_2 concentration taking into account the assumption that Gwacheon is located within the Seoul-Incheon metropolitan airshed with relatively high SO_2 concentrations. Regarding the TSP data, it suggests that Gwacheon, at present, is exposed to comparably high particulate concentrations. This may be due to many ongoing construction activities and thus due to fugitive emissions.

The major air pollution concern focuses on the insufficient height of the stacks of heating plants already in operation or being planned compared to the height of the apartment buildings. This concern is supported by calculations based on the Gaussian plume model for continuous sources.[1/] This model has been applied for a stack with a physical stack height of 30 m with regard to downwind concentrations at different heights of the receptor, i.e. the height of 15 storey apartments which are located in about 250 m distance from the stack in NE to ENE direction. The downwind concentrations have been calculated for different stability classes and wind speeds at different receptor heights z based on equation (2):

1/ Hanna, S.R. Briggs, G.A. Hosker, R.P. Handbook on Atmospheric Diffusion, Technical Information Center, US Department of Energy, 1982.

$$(2)\quad C(x,z;H) = \frac{Q}{2\,\delta_z\,\delta_y u}\left\{\exp\left[-\tfrac{1}{2}\left(\frac{z-H}{\delta_z}\right)^2\right] + \exp\left[-\tfrac{1}{2}\left(\frac{z+H}{\delta_z}\right)^2\right]\right\}$$

which is derived from equation (3) for y = o:

$$(3)\quad C(x,y,z;H) = \frac{Q}{2\,\delta_z\,\delta_y u}\exp\left[-\tfrac{1}{2}\left(\frac{y}{\delta_y}\right)^2\right]\left\{\exp\left[-\tfrac{1}{2}\left(\frac{z-H}{\delta_z}\right)^2\right] + \exp\left[-\tfrac{1}{2}\left(\frac{z+H}{\delta_z}\right)^2\right]\right\}$$

At neutral stability and wind speeds of 2.5 m/sec and 5 m/sec, respectively, the following SO_2 concentrations occur at different heights at the receptor (Table 11):

Table 11: Downwind SO_2 Concentration

Unit: $\mu g\ SO_2/m^3$

Height / Wind Speed	z (m)				
	50	40	30	20	10
v = 2.5 m/sec	47	28	15	7	3
v = 5 m/ sec	58	48	37	26	19

For extremly stable conditions, one obtains the following concentations (Table 12) :

Table 12: Downwind SO_2 Concentration for Extremely Stable Conditions

Unit: $\mu g\ SO_2/m^3$

Height / Wind Speed	z (m)				
	50	40	30	20	10
V = 2.5 m/sec	62	30	13	5	-
v = 5 m/sec	96	76	52	30	16

Though the frequency of the occurrence of these specific atmospheric conditions per year is not high, the calculated concentrations are significant. Moreover, at the 15 storey apartments located at the ENE downwind edge of the study area, superposition of concentrations resulting from the different stacks located upwind will occur, leading to even higher concentrations. The stack heights are considered to be too low for the given situation.

b. Environmental Impact

The assessment of the impacts caused by the observed concentrations of the different criteria pollutants can reasonably only be based on the comparison of these concentrations with corresponding ambient air quality standards. In order to relate measured air pollutant concentrations to air quality standards, measured concentrations must be expressed as a function of averaging time and frequency. Unfortunately, for the given monitoring data this can not be reasonably done. Yet, the estimated emission rates and the results obtained from the SCAM model suggest that the concentrations of the criteria pollutants are within safe limits and will also not exceed ambient air quality standards after completion of the new town.

SO_2 concentrations at major downwind directions of heating plant stacks predominantly in the winter months, however, cause some concern, particularly in conjunction with relatively high particulate concentrations exceeding the 24hr annual maximum concentration (150 $\mu g/m^3$) of the secondary U.S. standard. It is anticipated that the particulate concentrations will decrease as soon as all construction activities are completed.

Public health effects due to air pollution are not to be expected. Effects on sensitive vegetation such as conifers and visibility impairement resulting from air pollution can, however, not entirely be excluded.

c. Mitigation Measures

In general, the stack height of major single sources, e,g., central heating plant stacks or stacks of public bath houses where considerable amounts of fuels are burnt, should be 2.5 times higher than the surrounding buildings. For Gwacheon, this requirement is not met. In fact, the 15-storey apartment buildings are higher than the 30 m high stacks of 6 heating plants. Therefore, it is recommended either to use lower sulfur containing fuels or to increase the stack heights considerably. This measure, however, has to be carefully assessed with regard to the topographical conditions characterized by high mountains to the north

and south covered with sensitive vegetation.

If the stack height would be increased from 30 m to 60 m, a considerable reduction of groundlevel concentrations and concentrations at different receptor heights would be achieved. The difference in costs of one stack of 30 m height compared to a 60 m high stack will be about ₩ 40,000,000, correspondingly for all 6 stacks of the development area ₩ 240,000,000.

In case one (1) percent sulphur containing diesel oil would be used instead of 1.6 percent sulphur bunker-C oil, the difference in cost would be approximately ₩ 996,000,000/year.Consequently, from a cost point of view the increase of the stack height is by far preferrable. 1/

Along roadsides, sufficiently wide buffer zones planted with trees or bushes are recommended. In addition, the traffic light system should be controled in such a way that a smooth traffic flow at reasonable speeds is guaranteed throughout the whole new town area, particularly at major arterial roads.

5. Noise Pollution

a. Environmental Setting

Noise pollution has become a major environmental problem, predominantly in major cities. The public nuisance due to noise from road traffic has increased owing to the increase of the traffic volume, especially of heavy vehicles such as heavy-duty trucks and heavy-duty diesel-fuelled buses. Gwachon in this regard, is no exception (see section transportation). In addition, noise from commercial aircrafts while crossing the new town development area in comparably low attitudes in order to land at Seoul international airport is another major source of noise. Ongoing construction activities increase the noise levels. Neighborhood noise is comparably high.

1/ It has to be recalled that the increase of the stack height can solve local problems but has to be carefully assessed from a regioual, national or even global point of view for greater stack heights.

According to a noise survey in Gwachon carried out by the research team, the equivalent continuous sound level (L_{eq}) at the main traffic road side (30 m away from the center of the road) exceeded 70 dB(A) during daytime. Simulataneous traffic counts showed a traffic volume of about 2,000 vehicles per hour, out of them about 38 per cent heavy-duty vehicles. Noise measurements at the same site carried out in the evening resulted in only slightly lower L_{eq} s. The L_5 amounted to 74 dB(A) at this time, indicating that the noise level exceeded 74 dB(A) for 5 per cent of the time.

Equivalent continuous sound levels in the center of one apartment area reached 59.5 dB(A) during daytime and 54.5 dB(A) during evening time. Background noise levels measured in considerable distance from roads and neighborhood noise sources amounted to 48 dB(A) at daytime and 47 dB(A) at evening time. At the latter time, the influence from aircraft noise is significant at this site. The results of the noise survey in Gwacheon are given in Table 13. Unfortunately, nighttime noise levels could not be determined.

b. Environmental Impacts

In the past, concern about the effects of noise on health has been largely confined to occupational and industrial environments. However, owing to the rapidly increasing noise levels from many sources predominantly motor vehicles, such concern has spread to urban and particularly residential environments. The WHO Expert Committee on Environmental Health Aspects of Metropolitan Planning and Development[1/] which was held in 1964 noted that noise and vibration are known to exert deleterious effects on numerous organs of the human body, especially on the nervous-system. Particularly nighttime noise causes adverse effects already at comparably low levels. The objectively demonstrable impairements of the sleep commence at peak levels of 45 to 50 dB(A). This corresponds to an indoor L_{eq} of 30 to 35 dB(A), equivalent to an outdoor L_{eq} of 45 dB(A) for open windows and 55 dB(A) for closed windows, respectively. Noise effects depend also upon the noise characteristics, i.e., upon the type

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1/ World Health Organization Technical Report Series, No. 297, 1965.

Table 13. Noise Levels in Gwachon

Unit: dB(A)

Site \ Time	Day-time						Traffic Volume (cars/10 min)		Evening-time					
	L_5	L_{10}	L_{50}	L_{90}	L_{95}	L_{eq}	Light Duty Vehicles	Heavy Duty Vehicles	L_5	L_{10}	L_{50}	L_{90}	L_{95}	L_{eq}
Site A (Traffic Noise)	77.8	75.3	69.3	64.8	62.5	72.1	207	134	74.0	72.8	68.0	61.5	59.8	69.4
	73.8	72.5	68.5	63.3	61.8	69.4	204	107						
Site B (Residential)	63.0	60.0	53.8	49.5	48.0	59.5			57.5	55.5	50.5	46.8	45.8	54.5
	63.0	61.5	54.3	50.5	49.5	58.3								
Site C(Background)	54.8	53.5	45.6	43.0	42.0	48.0			54.5	51.5	41.3	38.0	37.3	47.4

Table 14. Noise sources in Gwachon

Site \ Time	Day-time	Evening-time
A	motor vehicles	motor vehicles
B	neighborhood, motor vehicles, aircraft	neighborhood, motor vehicles, aircraft
C	aircraft, neighborhood	neighborhood (seldom), aircraft

of noise (impulse noise vs continuous noise), noise level fluctuations, duration, etc. In addition, other factors play an important role whether noise at lower levels is considered a nuisance, for example the overall environmental quality, kind of acitivity, the time of the day, the neighborhood structure, etc. Although explicit criteria for noise control in urban planning are still not well developed, a good deal is known about these aspects, and some countries have already taken legislative action with a view to institute control measures. Table 15, for example, lists the noise levels (L_{eq}) for different types of districts in the Federal Republic of Germany (FRG) which are considered as guides in urban planning.

Table 15: Noise Level Goals ("guiding values for planning") in Various Types of Districts in the FRG 1/

Type of Area	Time	Noise Level L_{eq} in dB(A)
Industrial and small business areas	-	70
Predominantly small business areas	day night	65 50
Areas with small factories and apartments	day night	60 45
Multifamily residential districts	day night	55 40
Single-family residential districts	day night	50 35
Zones of hospitals, nursing homes, recreation areas, etc	day night	45 35

In this context it has to be pointed out that these noise levels are considered as long-term goals which can not be realized in the short-run if the existing situation is characterized through an unfavorable coexistence of residential and industrial areas. However, recently a Traffic Noise Protection Law has been promulgated in FRG establishing environmental quality standards for noise which is caused by road traffic. According to this Law the following standards should not be exceeded (Table 16):

1/ Technische Anleitung zum Schutz gegen Lärm (TA Lärm), 16 Juli 1968, Bundesanzeiger Nr. 137.

Table 16: Environmental Quality Standards for Noise which is Caused by Road Traffic in the FRG 1/

Type of area	Time	Standard L_{eq}(dB(A))
Multi-family and single-family residential areas	day night	65 55
Mixed areas	day night	70 60
Small business and industrial areas	day night	75 65

If the above standards for residential areas are applied to Gwacheon new town, the existing noise levels exceed these standards. It is obvious, that the noise levels will even increase after the completion of the development due to an anticipated substantial increase of the traffic volume. Consequently, impacts primarily from traffic noise in the form of sleep impairments or, generally, public annoyance can be expected.

For example, a poll carried out in Düsseldorf, FRG revealed the following relationships between road traffic noise and annoyance reactions of the public affected (Table 17).

1/ Verkehrslärmschutzgesetz, 6. März 1980.

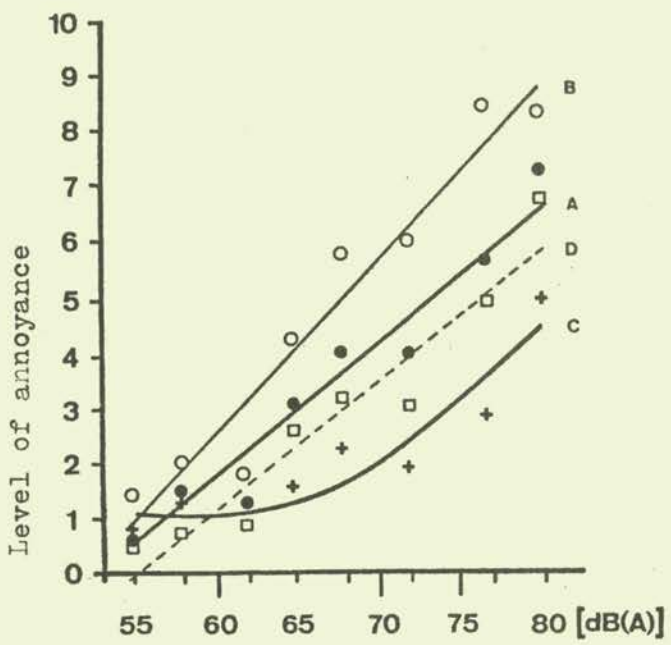
Table 17: Relationship between Road Traffic Noise (L_{eq}, dB(A)), Kind of Annoyance (how people react) and Level of Annoyance; Average Values of Citizens Included in the Poll 1/

A = overall annoyance reaction caused by road traffic noise

B = generalized sensorial annoyance reaction

C = somatic and emotional annoyance reaction

D = acoustic-physical annoyance reaction



In this context it has to be recalled that the new town development area was planned based on the objectives to meet the requirements of a comfortable urban environment. From this point of view noise mitigation measures have to be developed and implemented.

1/ Kastka, J. und Buchta, E. Zum Inhalt der Belästigungsreaktion auf Straßenverkehrslärm, Kampf dem Lärm 24, 158 (1977).

c. Mitigation Measures

Maximum noise levels are expected along the by-pass road since this road will absorb the majority of the through traffic from Seoul to Anyang and vice versa. Consequently, the 5-storey apartments located in about 45 m distance from the center of this road will predominantly be affected by road traffic noise. Since noise levels of over 70 dB(A) are expected during daytime and at least 60 dB(A) during nighttime at the closed windows of these apartments, a noise level reduction of at least 5 dB(A) is required.

Among the different possible mitigation measures, the construction of a mound along this road is recommended. The mound should be located as close to the road as possible. Based on a rough calculation the mound should have a height of about 5 m, a base width of 3 m and an angle of 55^{o} of the side facing the road. The estimated length should be about 3500 m. This mound would reduce the noise levels by about 8-10 dB(A). The construction of the mound would be valued as Won 110,000,000. It offers the advantage that trees or bushes can be planted which do not only improve the visual impression but also further reduce noise levels depending upon the kind and density of planting (see section of visual/aethestics/attractiveness). In addition, mounds are less costly than noise protection walls. However, at the planned intersection of the by-pass road, due to limited available space, the construction of a noise protection wall is proposed. The height and length have to be carefully assessed based on the given situation.

Apart from these effective mitigation measures, additional noise abatement measures are recommended. They include the careful selection of bus stops in the new town area not only from the convenience and traffic management but also from the noise protection point of view, the strict limitation and enforcement of the speed of motor vehicles, the control of the traffic light system in order to guarantee a smooth traffic flow, and the restriction of the use of horns. Some of these measures will concurrently be beneficial with regard to the air quality in the new town area.

6. Energy and Utility Services

Here we have used the concept of substandardness in regard to urban development in order to assess the level of adequacy of utility services.

Energy Conservation

a. Impact Assessment :

In recent years, energy utilization has become one of the central questions of environmental concern. The guideline for the Preparation of a City General Plan explicitly stated that one of the fundamental objectives of city development is to realize the impact of the conservation of energy, water and land resources on the development of the nation and overall society, and to take energy conservation into consideration in establishing urban development policies. 1/

According to the Gwachon New Town Development Plan, the future image of the Gwachon new town is a model and considered a leading city, performing self-sustainable roles through a rational allocation of urban functions. A typical neighbourhood unit in Gwachon provides primary schools, shops and green zones within walking distance. Newly built neighbourhood centres provide a bakery, medical practices, pharmacies and restaurants. Bicycle roads will link parts of the town by a cycle network. A large portion (60%) of planted trees is deciduous trees. 18 new houses are solar-heated.

Internal fuel consumption in the area includes city gas burned to cook, coal briquette and electricity and bunker-c to heat homes, and electricity to operate lights, lifts, motors, etc. The high-rise apartments (14 & 15 storeys; 3,310 dwelling units) will use lifts driven by electric power, and create a new source of demand for irrecoverable resources, i.e. approximatley 390 KW

1/ Ministry of Construction, The Guideline for the Preparation of City General Plan, Seoul, 1981, P. 13.

The survey conducted by the author reveals that a large proportion (95 percent of employed residents serving as a sample) is involved in journeys to other towns. Thus, it has accelerated energy consumption resulting from long-distance traveling. As previously discussed, the transportation facilities in the area are inadequate to meet the transportation needs of the community at the present time. The resulting congestion means wasting of time and energy.

To quote from a Chosun Daily Newspaper article(25-7-82),

"The Ministry of Health and Social Welfare which has already moved to the 2nd Government Hall in Gwachon has a lot of inconveniences as compared with the time when it was in Sejong-Ro, downtown Seoul .... The bureau directors who are rationed 200 litre per month for their own cars are experiencing severe oil shortages due to many long-distance travelings in order to attend meetings with the authorities concerned in the Capitol Hall .... "

At present there is a considerable lack of knowledge of the distribution of both somatic energy and extra-somatic energy in terms of space and among income groups and of the nature of types of usage, and of the patterns of material flows in the town. There is a need of more in-depth studies on the pattern of energy and material flows, and a search for more efficient methods of energy and materials use in the Gwachon new town.

b. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer :

- The contractors should be required to submit evidence that energy conservation codes of the Ministry of Energy and Resources and the Korea Energy Management Corporation have been utilized in the design of all structures. In particular, building design should incorporate such features as adequate insulation so as to minimize the use of energy.

(2) Other measures that could be incorporated :

- Air conditioning and heating equipment should be designed so as to minimize the use of energy.
- Low energy consuming lamps should be utilized for parking lots and street lights. Parking lots and street lights should be operated only at enough darkness.
- More use of bikes should be encouraged to stimulate energy conservation.

Sanitary Sewers

a. Environmental Setting

The existing houses were serviced by individual septic systems without proper treatment.

b. Impact Assessment

600 litre of proposed daily maximum sewage flows per capita were calculated from a total of 500 litre of daily maximum water units plus 100 litre of ground water flows per capita. The proposed daily average sewage flow was derived from 75% of the daily maximum sewage plus ground water flows.

Table 18. Calculation of Sewage per Capita

unit: litre pcd

Classification	General Sewage	Underground Water Flow	Total
Daily average sewage per capita	500 x 0.75 = 375	100	475
Daily maximum sewage per capita	500	500 x 0.2 = 100	600

Approximately 29,925,000 litre of wastewater per day would be generated by the 14,200 dwelling units housing 63,000 people at full occupancy. If we add to this figure wastewater (3,200,000 litre per day) which would be generated by the development of the 2nd Government Hall, the total amount of wastewater would be 33,125,000 litre per day.

The anticipated discharge from the site will be treated by the Gwachon Wastewater Treatment Plant which has a design capacity of 30×10^6 litre of effluent per day (Table 19). The construction of the plant will cost Won 8,600,000,000.

Table 19. Sewage Treatment Capacity

Areas	Daily Maximum Treatment Capacity (ton/day)	Daily Average Treatment (m^3 / day)
Gwachon New Town 1/	26,000 (87%)	20,800
The 2nd Government Hall	4,000 (13%)	3,200
Total	30,000	24,000

The anticipated discharge from the site is above the 30 million litre design capacity of the plant system.

At present, the wastewater discharges to the main stream with treatment in individual septic tanks which are installed in each block, but may not be mitigated to a level to meet standards for the discharge of water to the Han-River. This adverse impact may have short-term cumulative impacts until the treatment plant is completed. Discharge water quality levels could be reduced to acceptable levels presented in Table 20 if properly treated.

Table 20. Discharge Water Quality Standards after Treatment

Item	BOD	SS	Remarks
Target level	30 PPM	70 PPM	Environmental Preservation Law
Design level	20 PPM	30 PPM	Treatment Efficiency Considered
Reduction Ratio	90 %	85 %	

SOURCE : Ministry of Construction, unpublished material, 1982.

1/ This area does not include the 2nd Government Hall site and has been developed by the Korea National Housing Corporation.

c. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer :

- Individual septic tanks be installed until the wastewater treatment plant is completed.
- A wastewater treatment plant be installed to reduce 200 ppm of BOD and 200 ppm of SS to acceptable levels. The cost of construction would be Won 8,600,000,000.-

(2) Other measures that could be incorporated:

- Design capacity of the plant system should be revised to treat the anticipated discharge from the site. The extra cost would be Won 800 million, for the expansion from 30,000 ton/day to 34,000 ton/day of design capacity.
- Construction of the treatment plant should be implemented to reduce even short-term cumulative impacts to an acceptable level as soon as possible.

Solid Waste

a. Environmental Setting

Before the development, difficulties arising from inadequate waste disposal systems were not significant. The solid waste from coal-burning in domestic heating and cooking systems may have, however, been a serious problem in this area because coal was extensively used.

b. Impact Assessment

Many of the problems generated by urban development are associated with domestic wastes. Solid domestic refuse is the major form of urban waste. The Office of Environment estimated that 1.6 Kg of solid waste was produced per capita per day in Korea in 1979.[1/]

1/ Information on Refuse in Korea, OOE, Solid Waste Management Division, 1980.

According to a study carried out by Yonsei Univeristy in 1978 [1/], the solid waste discharge per capita per day will reach about 3.5 Kg in 1985. Therefore, a conservative estimate for the generation of solid waste for Gwachon new town yields about 2 kg of waste per capita per day, resulting in 126,000 kg per day at full occupancy. The volume of solid waste generated by the proposed project is significant.

At present, solid waste is removed from the site and deposited at the Anyang and Nanji Island (Seoul) landfill sites. When Gwachon becomes an autonomous city, the city will assume all maintenance responsibility. Thus, it will have to dispose safely all solid wastes generated.

From a solid waste management point of view, the sanitary landfilling method is by far preferrable. It is not only much cheaper than incineration (it is estimated that in Korea for one ton of domestic waste incinerated Won 20,000 must be spent compared to less than Won 1,000 per ton disposed at a sanitary landfill site), but offers also a number of other advantages. Landfilling operations can be carried out without any risk to environmental resources (air, water, etc.) if it is done according to professional standards. It is an important method for "land reclamation." If carefully planned, methane gas can be recovered from landfill sites and used as an important source of power generation. In contrast, incineration does not completely dispose of domestic wastes since it only burns organic materials--landfill sites are still needed for the disposal of the residuals. Moreover, even if well controlled an incinerator still causes air and land pollution.

In general, development costs for landfill sites are by far cheaper than construction costs of incinerators. A landfill site has to be carefully selected and engineering work has to be done to prepare the site. A drainage system can be constructed to collect any leachate which can be sprayed back on the landfill site. It has to be stressed that Korea has no lack of suitable landfill sites.

1/ Kwon, S.P. and Chung, Y. A simulation of solid waste generation in Korea, Institute for Env. Res., Yonsei University, Seoul, Oct. 1978.

c. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer :

A sanitary landfill site will be located approximately 1.5 km south of the town. An incinerator has also been proposed, but this proposal has not yet been accepted. It is strongly recommended here, do disregard this proposal due to the above reasons. The estimated costs for landfilling and incineration (30,000 m^2) of Won 2,400,000,000 can be dramatically reduced if incineration is not considered as a proper means of the disposal of the generated domestic waste.

(2) Other measures that could be incorporated :

The existing landfill site could either be extended or an additional site could be developed.

Water/Power/Communication

a. Environmental Setting

Existing utilities included a region-wide electric network (154 kV., 1.34 km length), an area-wide water service pipe from Paldang to Anyang and Banweol, a Gyonggi water service pipe from Seoul to Anyang and Suweon, a communication pipe and an electric network. These utility connections were available for the proposed site and become an integral part of the infrastructure as far as utilities and services are concerned.

Most of the existing households had their water from wells and only thirty households from simple water supply.

b. Impact Assessment

Underground utility ducts were designed to house such utilities such as electric cables, communication cables, water supply pipes and district heating pipes according to the characteristics of utilities to be collected (Figure 11).

Main Line 1/ Branch Line

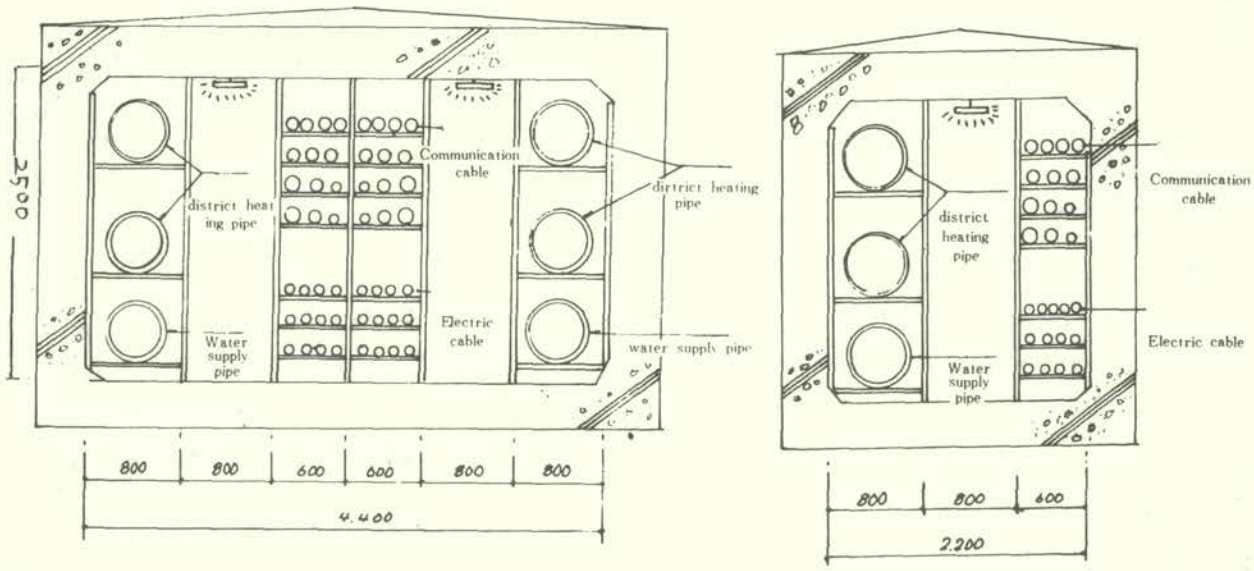


Figure 11. Underground Utilities Collector

The site receives its water from the transmission pipe of 2,000 mm in diameter provided under the 2nd overall water supply program in the Seoul Metropolitan area. Water service is provided to the site by the Gyonggi province from the Paldang reservoir located at the upper stream of the Han-River.

1/ The Ministry of Construction and the Korea National Housing corporation, Gwachon New Town Development Plan, Seoul, 1979, P. 49.

The water is purified by the water purification plant which has a design capacity of 30,000 ton of water per day(Table 21). The construction costs amount to Won 1,191,000,000.

Table 21. Water Supply Capacity of the Water Purification Plant

Capacity / Area	Daily Maximum Treatment Capacity (m^3/day)	Daily Average Treatment Capacity (m^3/day)
Gwachon new town	31,200	26,000
The 2nd Government Hall	4,800	4,000
Total	36,000	30,000

The proposed daily consumption per capita is 380 litres. Thus, approximately 23,940 m^3 of water per day will be required by the 14,200 unit development (63,000 people) at full occupancy.

If we add to 23,940 Ton 4,000 m^3 per day which will be required for the 2nd Government Hall, the total consumption will be 27,940 m^3 per day. The estimated consumption of 27,940 m^3 per day is within the 30,000 m^3 per day design capacity of the plant system. Although these figures have verified that the town can handle the increased water demand imposed by the proposed project, the actual water supply is currently only 8,500 m^3 per day which are allocated for the Gwachon new town by the Gyonggi Province. Additional allocation of water from the Paldang reservoir will be necessary to meet the increased water demand. The current consumption of 4,250 m^3 per day is within 8,500 m^3 per day which have been already allocated to the Gwachon new town.

With the installation of the Water Purification Plant, the direct effect of the project will enable the Paldang reseroir to provide full water service to the Gwachon town.

The Office of the Gwachon Water Purification Plant has estimated that approximately 51 people are employed permanently and 5,000 people were employed during construction. Consequently, the employment at the plant has assisted in alleviating some of the unemployment found in the town and the Siheung county.

A secondary effect of the water project would be to enable the town to move ahead with possible plans to allow future development of the residential and commercial areas known as "Seoul City Planning Area".

Electricity for lighting, power, heating, and other purposes is provided by an existing transmission line(154 kV) passing through this planning area which is a main line of the loop system covering the nation. This planning area is, therefore, suitable for placement of a transmission installation. 23,100 m^2 of a transformation plant site were designated within the eastern greenbelt of the planning district. This site costs Won 1,200,000,000. The electrical distribution system of Gwachon new town was designed to be accomodated by a collector or pipeline system and by direct burying considering beauty and safety of the area. The cost of construction was Won 9,700,000,000. The increasing electric load will not necessitate any changes in the town's electrical distribution system because anticipated electrical consumption (77,750 kW) to be generated by the project development is within the approximately 200,000 kW design capacity of the electrical distribution system.

The installation of a subway system will require distribution of additional electric power (10,000 kW) to the proposed project. However, the existing electric power distributing station has enough capacity to accommodate such development in the area.

Residents are currently paying Won 120 per kilowatt-hour.

The new town is located about 8 km from the Anyang Telecommunication Office, and 6 km from the Sadang Telecommunication Office, Seoul. The new town will require much more business lines than those of other cities because of the 2nd Government Hall and many public offices. Consequently, public offices will require more specialized lines in future.

Required lines in the target year are as follows :

- Relay line between Gwachon and other cities : 1,500 lines
- Subscriber's lines : 20,000 lines
- Data lines for government agencies and public offices : 5 lines by agency (or office).

For the 2nd Government Hall and the Head Office of Gwachon New Town Development, the Korea National Housing Corporation installed an inner-city system which connects with the Banpo Telecommunication Office, Seoul. General subscribers use the long distance system. The Gwachon Telecommunication Office Building is still under construction and will be completed by the end of 1983.

The complaints voiced by residents concerning the telephone service in their new town are related to the long-distance system. 229 out of 381 respondents, i.e. 60%, were persons dissatisfied with the telephone service in the town. The long-distance system in the town is apparently straining many communications between Gwachon and Seoul.

Although there are eight public telephone boxes in sites I, II and III, only a few people appear to use them due to the long-distance system.

c. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer :

- A water purification plant will be installed to supply water for the town. The construction costs amount to Won 1,191,000,000.

(2) Other measures that could be incorporated:

- Additional allocation of water from the Paldang reservoir will be necessary to meet the increased water demand.
- A Telecommunication Office should be built before newcomers arrive at the town. If residents agree to pay the extra cost for the change of the long-distance system to the inner-city system, detailed plans for telephone service may have to be re-examined.

7. Vegetation, Animal And Habitat

a. Environmental Setting : The site is located at the edge of Gwanak and Chyongge Natural Parks possessing excellent vista of sparse forest and feature landscape and favourable accessibility when developed.

The mixed forest of pine trees and oriental oaks in the woodlands composes the majority of the tree species in the natural state. The relatively dense vegetation covers most of both upper north and south slopes of the site. Within the confines of the project sites, other species are chestnut trees and bamboo. Ornamental trees are present in sizable quantity in the private nurseries. Orchards can be found on the site.

Table 22. lists those plant species found on the proposed project site.

The tree species preserved in this area are two maidenhair trees to be over 500 years, two zelkova trees to be 300 years, a 100 aged box tree, 30 to 40 aged pine trees and some species around most of the perimeter.

No rare or/endangered plant and animal species were detected during the field studies.

b. Environmental Impact

Indirect animal habitat loss would be mainly confined to the slopes of Gwanak and Chyongge Natural Parks due to the contiguous urbanization. In general, the loss of habitat would not be a significant adverse impact since there are no rare and endangered plant and animal species.

A major element of the master development plan is to remain over 38,897 m^2 as open space around most of the perimeter. The landscaping program specifies a landscaping concept for completely restructured residential areas, which consist of revegetation of 0.5 tree/m^2 for shrubs and 0.3 tree/m^2 for trees.

Table 22. Trees on the Proposed Development Site [1/]

Species	Age (years)	Diameter (cm)	Number	Location	Displacement or Preservation
(The First Stage Development Area)					
Vineyard	10		1,100	Orchard	Displacement
Chinese Juniper	10		1,100	Nursery	Displacement
(The 2nd Stage Development Area)					
Pear	15		2,000	Orchard	Displacement
Vineyard	15		2,500	Orchard	Displacement
Chinese Juniper	15		8,000	Nursery	Displacement
Maple	10		1,500	Nursery	Displacement
Japanese Red Pine		15	400	Forest	Preservation
Oak		30	35	Forest	Preservation
Pitch Pine		15	120	Forest	Preservation
(The 3rd Stage Development Area)					
Chinese Juniper	15		2,520	Nursery	Displacement
"	30		102	Nursery	Displacement
Kaizuka	32		85	Nursery	Displacement
"	20		52	Nursery	Displacement
Pear	15		400	Orchard	Displacement
"	10		591	Orchard	Displacement
(The 4th Stage Development Area)					
Chinese Juniper	15		200		Displacement
"	50		85		Displacement
Zelkova Tree	300		2		Preservation
Box Tree	100		1		Preservation
Chestnut Tree	100		23		Displacement
Maidenhair Tree	500		2		Preservation

1/ Tree diameters were measured at the breast height. Height and age are estimates. In forests, number and diameter were estimated based on a sample survey method.

The proposed dwelling units will be aesthetically treated and landscaped following the garden city concept.

The provision of additional park and open space to be landscaped with selected trees, shrubs, and ground covers would create viable animal habitats as well as an aesthetically pleasing environment. Therefore, the completion of this project will also benefit shrub and tree dwelling bird species such as, House Finches, Dove species, Starlings, and House Sparrows.

c. Mitigation Measures

(1) Measures incorporated into the design of the project by the developer :

- Over 38,897 m^2 will remain as open space around most of the perimeter.

- Smaller open space to the south of the project will be preserved for people as neighbourhood parks.

- Most of Yangjae river will be preserved as open space.

(2) Other measures that could be incorporated :

- The developer to buy trees scheduled for removal in order to landscape the site with plants which are grown under local conditions.

- Landscaping with fruit trees and berry bushes to supply food for residents and to attract shrub and tree dwelling bird species to residential areas.

- Avoiding the use of tree species in landscaping that are likely to transfer disease to adjacent agricultural crops.

B. Socioeconomic Factors

1. Land Use And Zoning on Site and Surrounding Area

a. Environmental Setting

Most of the 2,300,000m^2 (the 2nd Government Hall site excluded) of Gwachon town were agricultural land. The land use statistics presented in Table 23 indicate that 58.9 percent of the land were paddies and dry fields and 14 percent forest.

Table 23. Status of Land Use

Classification	Area (m^2)	Percentage of Composition
Paddies	823,500	35.8
Dry Fields	530,400	23.1
Building Site	377,700	16.4
Forest	322,400	14.0
River	129,600	5.6
Road	116,400	5.1
Total	2,300,000	100.0

Structures on the site included houses, an iron tower with high voltage, an oil pipe, an area-wide water service pipe, the Kyonggi water service pipe, a communication pipe, an electric pole, a communication pole, and the Mangyong Dae(means a tower to look out toward the capital Seoul).

The project site was occupied with 824 single-family homes. These single-family dwellings formed rural villages on several small lots, serviced by individual conventional septic systems, intersparsed with orchards, nurseries and agricultural land.

Most of the parcels surrounding the proposed project site are zoned green belts and undeveloped.

b. Impact Assessment

Land use and density are often used to indicate the quality of the living environment. In this study, the land use impact is referred to as the process of land use conversion. Changes in land use associated wity the development of the new town project are examined.

The Gwachon New Town Master Development Plan (adopted in September 1978) provides a basis for long range development goals and policies and their implementation.

According to the development plan, most of land parcels (46%) have been designated as sites for high density residential development. The proposed project site is divided into four districts, namely, an apartment district, a natural environmental conservation district, a business/fire prevention high density district and a fire prevention/high density district.

It may be worth noting that the loss of agricultural land arising from the new town development will be 1,353,900 m^2. At an estimate, about Won 111,000,000 will be needed to reclaim the same amounts of agricultural lands somewhere on the west coast.

Table 24provides an overall comparison of existing and planned land uses of Gwachon new town and land use standards established by the Japanese Housing Corporation 1/ relative to the three categories of land uses.

Table 24. Overall Comparison of Land Uses

Types of Land Uses	Existing Land Uses		Planned Land Uses		Japanese Housing Corporation Standards (%)
	Area (m^2)	%	Area (m^2)	%	
Residential/ Commercial/ Public Interest/ Institutional	377,700	16.4	1,330,907	58	75
Open Space/ Recreational	1,805,900	78.5	541,610	23	10
Road	116,400	5.1	426,023	19	18
Total	2,300,000	100.0	2,300,000	100.0	100.0

1/ Architectural Design Data Handbook, Vol. 5., 1972, P. 48

According to the Gwachon land use plan presented in Table 24, the development will preserve or create approximately 542,000 m^2 or 23 percent of the total 2,300,000 m^2 property as natural open space and parks. This figure is well above the Japanese standard or 10 percent of total property and below the American standard or 25 percent [1/] (see the section of recreation and parks for more detailed discussion).

The proposed project designates 14,200 dwelling units on approximately 1,060,000 m^2 residential areas. Table 2 provides a summary of the proposed housing development plan. (Also see Figure12).

Proposed Housing Development Profile

Stages	Total	Types of Housing			Remarks
		Detached	Attached	Apartment	
Total	14,200	696	644	12,860	Apartment 5 storeys: 9,550 dwelling units 14 & 15 storeys : 3,310 dwelling units Solar-heated houses : 18 units
Stage 1st	1,290	228	204	840	
Stage 2nd	6,075	235	-	5,840	
Stage 3rd	5,537	233	264	5,040	
Stage 4th	1,316	-	176	1,140	

The significant impact the new town will have on the Seoul Metropolitan region is clearer if we examine the proportion of the region's housing built since World War II.

Some features of building arrangements in new town development can be noted as follows (also see Figure 13).

i) To increase the vitality of urban life through creation of rhythm, sequence, orientation and dynamism of spatial structure.

1/ The U.S. National Recreation and Park Association recommends that a minimum of 25% of new towns be devoted to park and recreation lands and open space.

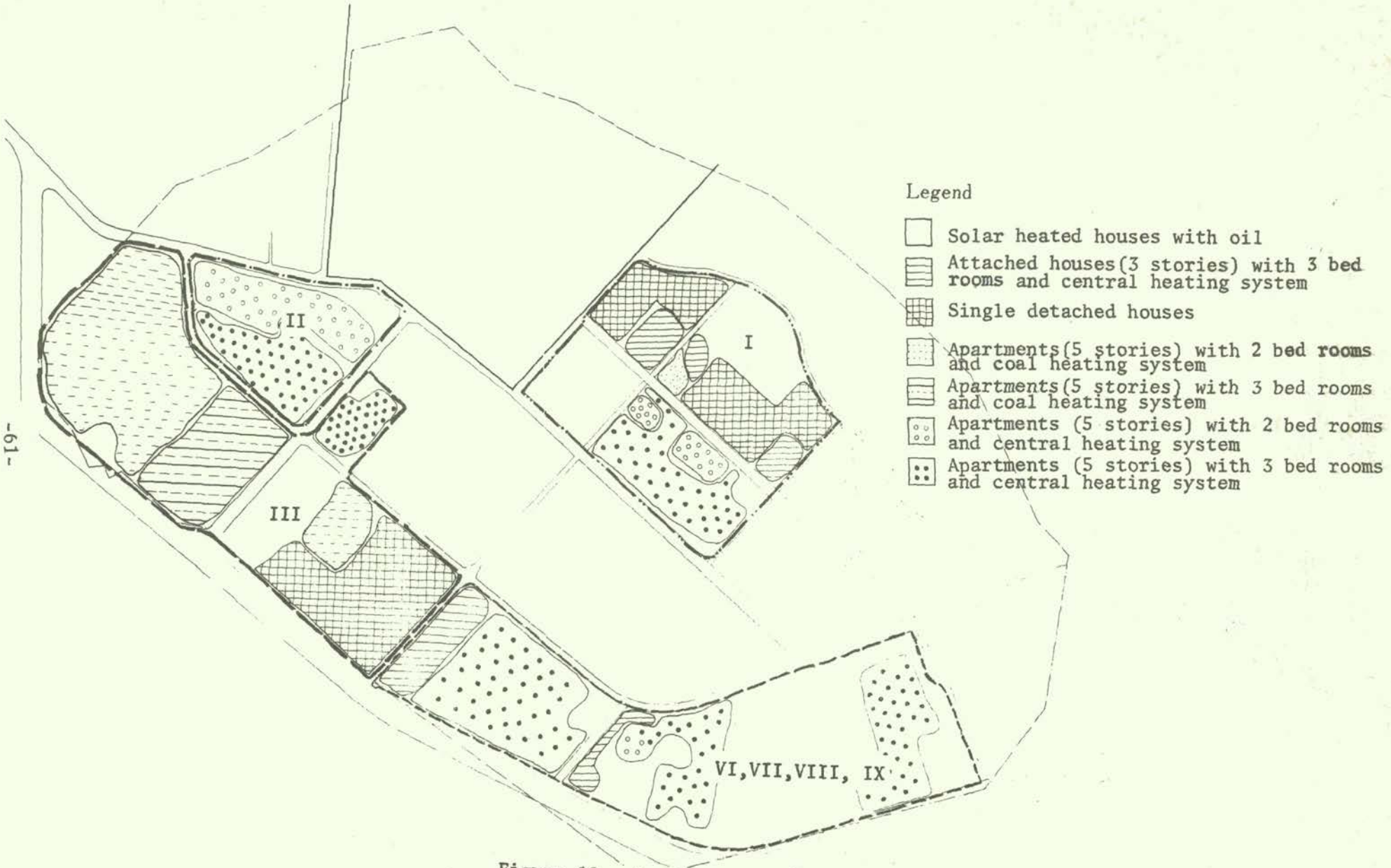


Figure 12. Housing and Apartment Cluster

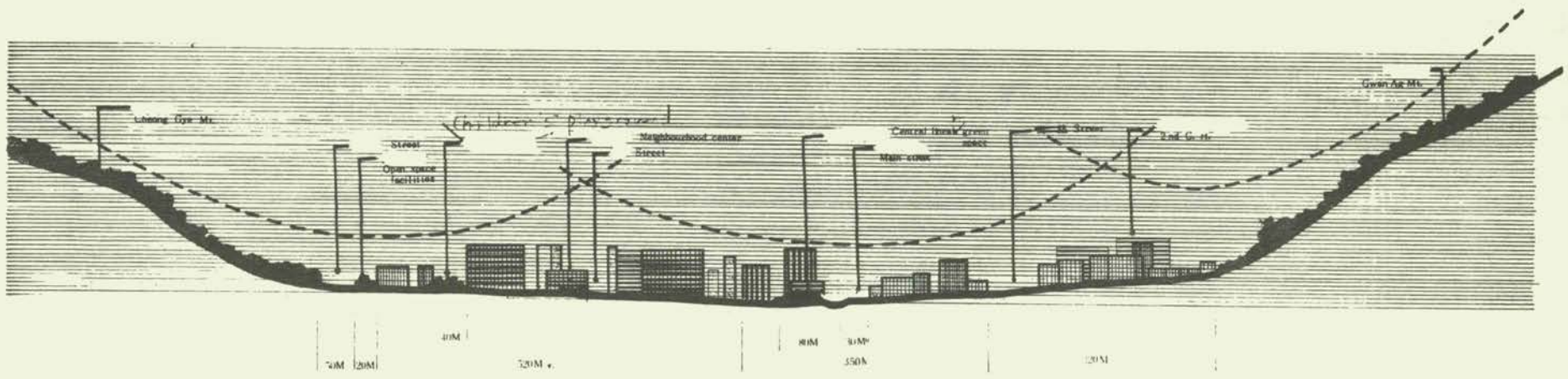


Figure 13. A Typical Cross-Section of the Planned Town

ii) To increase the beauty of the urban environment through harmonization of spatial elements.

iii) To increase the diversity of the spatial structure through total combination of local forms.

In practice, however, this approach largely negates any chance the town could have in creating a new form of living area, each with its local identifiable sub-spatial pattern, and places only a small number of countrified houses in the area.

In addition to changes in the type of land use activities in the project area, the effect of a proposed development on the intensity of land use may be significant in that these changes will affect other social and environmental variables which will influence other type of activities such as agricultural productivity of surrounding agricultural lands.

In regard to some types of use activities, intensity of use may be measured in terms of the number of persons per unit of area who are engaged in the activity. In the case of a new town development, the density can be measured in terms of the number of dwelling units or persons per unit of area.

As we can see in Table 25, the Gwachon new town will contain more people per unit of area than English and Japanese new towns do. The reasons for the high population density housed in Gwachon new town are related to the extent to which the new town will provide high value housing for employed residents who are working or will be working elsewhere, particularly in Seoul city which is the parent city of this particular bed town.

In addition, because the types of dwellings are not evenly distributed among neighbourhoods, such differences have had a considerable effect on neighbourhood population density within the town.

Table 25. Comparison of Density 1/

New Town	Area (ha)	Population/(Thousand Persons)	Population Density (persons/ha)
Senri	1,160	150	120
Kotzuzi	850	87	100
Senboku	1,520	188	120
Tama	3,000	400	130
Harlow	2,600	90	35
Cumburnauld	1,680	70	43
Runcorn	2,900	100	35
Hook(Plan)	3,000	100	33
Gwachon(Plan)	232	63	274

1/ Here the density is referred to as the gross density which divides the number of persons by the total project area.

Figure 14.shows the population density of site-adjacent cities.

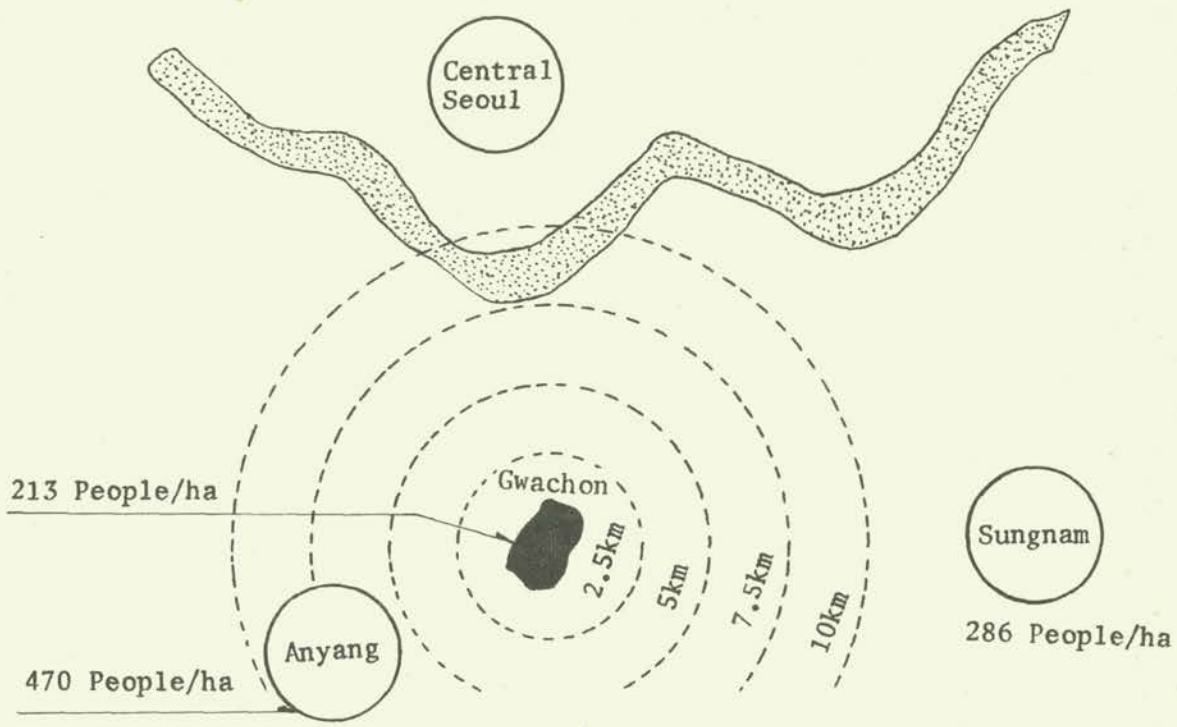


Figure 14. The Population Density of Site-adjacent Cities

Although the planned population density of the Gwachon new town is below that of Anyang and Sungnam city, it is anticipated that the actual Gwachon new town population density would be above the planned population density when fully occupied after completion of the project.

"The Guidelines for the Preparation of a City General Plan" 2/ set forth criteria for intensity of land use in areas designated for mixed density housing.

1/ This figure indicates planned gross population density whose area includes the 2nd Government Hall site.

2/ Ministry of Construction, The Guidelines for the Preparation of a City General Plan, 1981.

Table 26 presents a comparison of the actual population density by developable sites of the town and population density criteria that were established by the guidelines for the preparation of city general plan.

Table 26. Comparison of Population Density Criteria and Actual Population Density by Site.

Site	Status on Developed Sites						MOC Criteria
	Type of Housing	Dwelling Units	House-holds	Popu-lation 1/	Area (m^2)	Per-sons / ha	Persons / ha
Site I	Countryside Residential Area	29	63	309	7,188	429	80 2/
	Low Density Tenement House (3 Storeys)	180	212	661	18,000	367	200
	Low Rise Apartment (5 Storeys)	840	896	2,844	79,000	360	400
Site II	Low Rise Apartment (5 Storeys)	1,400	1,151	4,315	88,100	489	400
Site III	Countryside Residential Area	19	94	386	6,602	580	80
	Low Rise Apartment (5 Storeys)	3,330	3,644	13,982	209,802	666	400

In general, the housing density which is observed at sites I, II and III is above the density standards. It can be said that the projected population would be above 63,000 people of the target population when fully occupied.

1/ Based on the Permanent Resident and Housing Census carried out as of 1 October 1982 by the Economic Planning Board.

2/ This criterion may not be applicable under the given circumstances.

On the other hand, according to a survey carried out by the author between December 1982 and January 1983, the majority of respondents have not felt the population density be a major problem so far.

Table 27. Sense of Crowdness Voiced by Residents

Number of People Interviewed		%
Very Undercrowded	68	18
Undercrowded	68	18
Neither undercrowded nor overcrowded	164	43
Overcrowded	34	9
Very Overcrowded	23	6
No reply	24	6
Total	381	100

The Gwachon new town population density can be summarized as follows :

Type of Population Density	Persons/ha density
Originally planned population density	169 (including the 2nd Government Hall site)
Revised population density 1/	213 (including the 2nd Government Hall site)
	274 (excluding the 2nd Government Hall site)
Density based on the Permanent Resident and Housing Census as of 1 October 1982(only in the case of Sites I, II and III)	Average : 550 Site I: 366 Site II: 489 Site III: 663

1/ The target population of the town has been changed from 50,000 persons to 63,000 persons.

On the basis of this analysis, it is apparent that too many persons residing in limited space are of crucial importance in determining the success of the new town program. The high intensity of commercial, residential, or recreational uses may affect the availability of services and utilities, such as improved access roads, sewers, or fire and police stations.

Several reasons can be offered to explain the high population density in the town.

First, it has to do with the expense involved in building the single family dwelling units whose sites were sold to displaced people with some kind of preferences. Although the developer has compensated the displaced people for their property and business leases, the money shortage has been an obstacle in settling down in the town (see the section of dislocation of people). Thus, they offer rooms for people who can not pay the higher rents.

Second, like Sungnam city in the outskirts of Seoul, the Gwachon new town began to absorb overspill population from Seoul, such as some working-class people who can not afford to buy new independent dwelling units in the town but wish to reside there.

Third, large households may contribute to the high population in the town.

It is difficult to determine that the situation does necessarily improve as the town matures.

An adjacent undeveloped agricultural land southeast and southwest of the proposed site and to be bordered by the future by-pass road is used for farming. It is possible that human intrusions resulting in crop damage and fall in productivity may occur. Another danger here is the increase of derelict rural land - a twilight zone on the edge of the town where land values have already shot up the limit at which commercial farming is possible and yet the land is not immediately wanted for active urban development due to several reasons including controlled growth and regulations.

In fact, land values in urban-rural fringe areas have been affected by the continued urbanization.

To quote from a Chosun Daily News Paper article(26-1-83).

"It can be observed that speculation in anticipation of lift of green-belt zone has been made in forest within green-belt surrounding the Gwachon new town .... Thus, the price of forest land in this area has shot up from between Won 10,000 and 15,000 to between Won 70,000 and 80,000 during the period from the end of 1982 to the present. Even at this price, the shortage of forest lands to be sold had made it harder to buy them ...."

c. Mitigation Measures :

i) Measures incorporated into the design of the project by the developer :

- Incorporation of open space throughout the project. 542,000 m^2 will be dedicated by the developer to the town for the planned park and open space system.

- Installation of fencing to prevent human intrusions including tres-pass onto neighbouring agricultural lands.

ii) Other measures that could be incorporated :

- Reclamation of new agricultural lands equalling the lost land areas to complement the loss of agricultural land in the proposed site. The reclamation cost would be something like Won 111,000,000. Policy tools should be designed for this compensation in terms of the national strategic interest.
- Controlled growth on the surrounding area. By maintaining this open space element, flexibility in future land use is preserved.

- Efficient urban management to mitigate the adverse impacts of traffic, air pollution, urban heat-island phenomena, noise and demand on public services to be caused by over-crowdness. Some provisions have to be made for the housing needs of the people who share houses with the other tenants

on a rental basis for a relatively long time in this area.

- To provide more countrified houses to realize the garden city scheme.

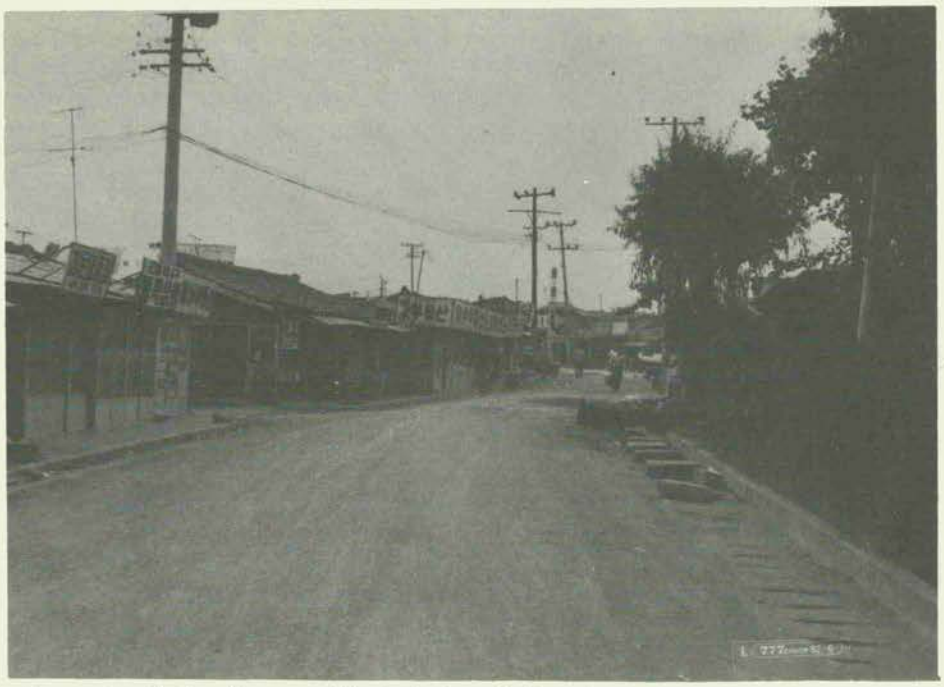
2. Dislocation of People and Villages

a. Environmental Setting

Historically, Gwachon has had its own tradition and a geographical entity with an identity distinct from the urban sprawl of metropolitan Seoul before the car has been given growing importance in Korean life. Today, all people and rural villages in this area have to be displaced since Gwachon has been subjected to the development in the form of replacement of existing villages with a new town project.

Site impact is best analyzed by reviewing various site segments visually-describing and comparing their existing and impacted conditions.

The following photos of these site segments were taken at several summer days in 1982.



View of central business district of Gwachon .
An elementary school is on the right of the road. The feature of the segment will be restructured completely to build apartments for the town residents. Shanty buildings create visual pollution in this area.

View of the stream connected to the Yangjae Stream.
The improved and straightened stream will be utilized for strolling by area residents. The access roads to the main road are on both sides of the stream. The site has not been landscaped with trees.

View of houses, stream and electric poles.
The site is without mature or native plants.
The housing mass will be dislocated and redeveloped. The land in between the stream and the residential area is presently cultivated.

View of wall and gutter in the residential area.
The wall serves as a visual and physical barrier between the house and the access road. The gutter in between the wall and the road have been formed for the storm flow and the sewage disposal, but are presently below the recommended standard.

In addition to the aesthetic elements of the proposed project, it may be worth noting on socioeconomic variables which have perhaps been most visible in regard to the quality of residential, commercial, and recreational developments in transfers from rural to urban areas.

(1) Population Characteristics

The population statistics presented in Table 28 indicate that the 1978 population of Gwachon was 6,840 people and 1,556 households. It is interesting to note that among 1,556 households were 1,399 non-farming households or approximately 90 % of the total households.

Table 28. Population Trend [1/]

Years	Population				Households			Population per Household
	Total	Increase(%)	Male	Female	Total	Farming	Non-Farming	
'72	4,070	-	2,039	2,031	753	210	543	5.4
'73	3,670	-9.8	1,840	1,830	629	182	447	5.8
'74	4,398	19.8	2,207	2,191	785	220	565	5.6
'75	5,124	16.5	2,612	2,512	915	265	650	5.6
'76	5,847	14.1	2,944	2,903	1,082	314	768	5.4
'77	6,578	12.5	3,324	3,254	1,265	367	898	5.2
'78	6,840	4.0	3,495	3,345	1,556	157	1,399	4.4

(2) Age Characteristics

The 1978 figures indicate that 61% of the Gwachon population was between the ages of 15 and 59, and 33% under 15, and 6% over 60

1/ The Ministry of Construction and the Korea National Housing Corporation, Gwachon New Town Development Plan and Design : The 1st Stage Report, Seoul, 1979, P. 25.

Table 29. Population by Age and Gender [1/]

November 1978

Ages	Total	Ratio(%)	Male	Female
Total	6,840	100.0	3,495	3,345
0 - 4	635	9.3	331	304
5 - 9	896	13.1	459	437
10 - 14	732	10.7	374	358
15 - 19	848	12.4	447	401
20 - 24	684	10.0	365	319
25 - 29	568	8.3	270	298
30 - 34	540	7.9	270	270
35 - 39	465	6.8	252	213
40 - 44	390	5.7	206	184
45 - 49	260	3.8	134	126
50 - 54	219	3.2	108	111
55 - 59	192	2.8	87	105
Over 60	411	6.0	192	219

(3) Economic Characteristics

Of the 1978 total population of Gwachon aged between 15 and 59 (4,166 persons), 61% of the population(2,541 persons) are in the labour force. The employment statistics indicate that the economic base of Gwachon depended heavily on the tertiary industry employment(51.4%, 1,306 persons), while the primary industry employment is 27.2%(691 persons), and the secondary industry employment 21.4% (544 persons).

1/ The Ministry of Construction and the Korea National Housing Corporation, Gwachon New Town Development Plan and Design : The 1st Stage Report, Seoul, 1979, P. 26.

b. Impact Assessment

In addition to changes in land use activity described in the previous section, project-generated effects on various types of improvements of land may be a source of significant impacts on the human environment. In general, improvements of land can be defined as any modifications that affect the utility of land for a particular human activity. 1/

The aesthetic impacts of the new town project may result from the removal of the existing villages and the addition of new-built dwelling units. The aesthetic impacts of land use improvements in this area will be discussed in the section of visual/aesthetic/attractiveness later in this study.

Aside from aesthetic effects, a number of other factors can be counted among the socioeconomic impacts associated with the dislocation of the existing villages and people. Here we have approached the issue of social impacts from displacement of the existing villages and people by identifying various "opinions" voiced by the existing residents.

The development of the Gwachon new town would entirely destroy the existing villages and generate 6,840 people to be displaced. When we decided to conduct a social survey of the peopled living in the Gwachon designated area, only the forth stage development area which is the core area of Gwachon-Myon has not been displaced yet. It was, therefore, decided that every household should be visited and interviewed within the Gwanmoon-Ri which is designated for the forth stage development area. These home interviews have been conducted to primarily obtain information on individual responses to the Gwacheon new town development-induced environmental changes.

Table 30 presents the number of households lived/living in the Gwachon designated area.

1/ Berns, T.D., The Assessment of Land Use Impacts, in McEvoy III, The late James and Dietz, T., Handbook for Environmental Planning: The Social Consequences of Environmental Change, John Wiley & Sons, 1977, P. 113.

Table 30. Number of Households to be Displaced.

Classification		Number of Households		
		The 2nd Government Hall Site	Other Area	Total
Owner-Occupied	1st Stage Development Area	89	172	261
	2nd Stage Development Area	-	217	217
	3rd Stage Development Area	-	87	87
	4th Stage Development Area	-	300	300
	Total	89	776	865
Tenanted	1st Stage Development Area	-	348	348
	2nd Stage Development Area	-	300	300
	3rd Stage Development Area	-	125	125
	4th Stage Development Area	-	390	390
	Total	-	1,163	1,163

Of the 690 households in the Gwanmoon-Ri area, 106 households were included in the final analysis.

Although the details of the social survey can be found in appendix II, some significant findings are discussed to understand the issue of social impacts associated with displacement of the existing villages and people.

Construction-related impacts are of crucial importance to the people who live in the Gwanmoon-Ri. Many single family residences of the survey area are particularly impacted by the heavy use of the existing main road through an increased level of dust, noise and night illumination.

The project will uproot current residents by physically displacing them from their homes and also displace workers by removing existing stores and other enterprises. When certain jobs are eliminated and not moved to a convenient new location or are substituted for by new jobs in the development, the net loss of employment could cause some people to leave the community entirely.

According to the survey carried out by the author, the loss of employment makes people to be uncertain about their future, although compensations would benefit them in the form of cash.

Out of a total of 106 people interviewed, 31% are facing uncertainty, without particular definite views (Table 31).

Table 31. Future Work Plan After the Development

Question - Do you have any definite future work plan after the development ?

Replies :	No.	%
Continuing Current jobs	71	67
Other	2	2
Don't Know	33	31
	106	100

Generally speaking, the impression obtained from these interviews was of many people without particularly strong views (Table 32).

Table 32. Time to Look for Another Occuptation

Questions : When are you likely to start looking for another occupation ?

Replies :	No.	%
At the earliest possible moment	20	19
In due course	17	16
When 'development' of present locality is imminent	19	18
No reply	50	47
	106	100

The expected impact on the family tradition of the proposed project site is significant. The majority of people contacted feel sorry about leaving their ancestors' hometown.

The developer has offered/will offer compensation to the residents, which would benefit them in the form of cash. Table 33 presents the amount of compensation by compensation type totaled to January, 1983.

Table 33. Compensation Details

unit : Won thousand

	Site		1st	2nd	3rd	4th(planned)	Total
Land	Area		85,229	182,726	194,481	38,058	
	Value		7,252,484	13,900,645	17,357,686	11,480,802	49,991,617
Obs-tacle	House	Dwelling unit	172	210	116	326	824
		Value	777,721	1,033,823	728,490	1,814,933	4,354,967
	Tree	Number	22,048	66,000	13,433	20	101,501
		Value	57,806	117,386	50,478	26,410	252,000
	Value Sub-total		835,527	1,551,209	778,960	1,840,343	5,006,039
Busi-ness Leases	Number		40	22	36	261	359
	Value		41,542	20,235	70,545	447,864	580,186
Value Total			8,129,553	15,072,009	18,207,199	13,770,009	55,178,770

Source : The Korea National Housing Corporation, January 1983.

It is interesting to note that with a few exceptions such as the head and leading persons of the village, the majority of the residents did not know much about the Gwachon new town development plan and compensation for their property and business leases (Tables 34 & 35).

Table 34. Awareness of Detailed Plans of the Gwachon New Town Development

Question - Are you aware of detailed plans of the Gwachon new town development ?

Replies :	No.	%
Yes	38	36
No	22	21
No reply	46	43
	106	100

Table 35. Awareness of Assistance and Compensation when Changing House or Locality

Question - Are you aware of any assistance, including compensation that may be available to assist you when changing house or locality ?

Replies :

	No.	%
Yes	37	35
No	35	33
No reply	34	32
	106	100

Many residents share unfavourable views of the compensation. Although the residents of the 1st, 2nd and 3rd stage development areas received the compensation fee decided by the developer, they may not have been the true beneficiaries of development area policy. According to the social survey of the 1st, 2nd and 3rd stage development areas conducted by the author, only a small portion of original Gwachon residents remain in Gwachon

Two reasons can be listed to explain leaving Gwachon .

First, as pointed out in the section of land use and zoning on site and surrounding area, it has to do with the expense involved in

building the single family dwelling units. Many residents faced the money shortage to build their own house on the land bought from the developer since the construction cost of a single family detached house would be approximately Won 44,380,000 (70 pyong 1/ of building site x Won 134,000 (special sale price) + 50 pyon of floor space x Won 700,000). Thus, many of them have sold their land at a premium to gain a benefit from the difference in the price of land. The difference would be valued at Won 25,620,000 for 70 pyong of building site ((Won 500,000/pyong(current market price) - Won 134,000/pyong (special sale price))x 70 pyong). If we assume 824 dwelling units would be displaced from this area, the total value would be Won 21,110,880,000.-.

Secondly the job shortage in the newly developed area has been a disadvantage for the residents who lost their jobs due to improvements to land. The town's failure to provide new direct employment may actually have contributed to migration from Gwachon since the lack of work in the area has made it harder to live there. This raises the business of rental housing.

It is not surprising, therefore, that we found in this study that many single family dwelling units have become overcrowded due to multi-households living together in one dwelling unit and large households.

So far, we made some assessment of the attitude and plans of the community to be affected. It would provide a 'backcloth' against which all subsequent changes can be measured in the follow-up studies of the future.

c. Mitigation Measures :

(1) Measures incorporated into the design of the project by the developer:

- To compensate the displaced people for their property and business leases. It would be valued at Won 55,178,770,000
- To sell the plot of single family dwelling units at a special sales price to the displaced people. The price difference would be valued at Won 25,620,000 per dwelling unit. If we assume 824 dwelling units would be displaced from this area, the total value would be Won 21,110,880,000

1/ One pyong equals to 3.594 sq. yds.

- To assist in the expense to be involved in moving to other areas from the area of origin.

(2) Other measures that could be incorporated:

- To install temporary buffer zones in order to protect the existing residents by minimizing construction related impacts from along the road, particularly in the phasing-in project like the Gwachon project.
- Provision of an economic base for the displaced people. Special sales price of stores built in this area by the developer would be offered for the benefit of displaced people. The reclamation programme described in the section of land use and zoning on site and surrounding area would be helpful to attract those people who hope to remain in farming.
- To fully publicize the details of development and compensation well in advance to make it possible for people to start looking for another house and occupation in due course.

3. Transportation

a. Environmental Setting :

Local traffic service to the site is provided by a through-traffic road (Kyonggi provincial road 395; four lanes, 15 m) which connects Seoul (Sadang-Dong) to Anyang. This road constitutes the only viable means of access from Seoul and connects to the southern circulation road which is a major road south of Seoul. (See Figure 7).

Before the project, inter-city public transport was poorly developed.

The major passenger travel mode was bus. One private bus line (the 97 route) operated between Seoul and Gwachon , and another bus line (the 1 route) between Anyang and Gwachon.

Average daily traffic volumes and its characteristics on the main road passing through Gwachon surveyed in 1978 are given in Table 20.

Table 36. Traffic Volumes (From 7:00 a.m. 24 October to 7:00 a.m. 27 October, 1978)

(Seoul⟶ Anyang) Unit : Vehicle trip/day

Survey Hour	Total		Bus			Lorry				Military Car			Passenger Car	Two-wheel-Vehicle
	Total of P.C.U.*	Total	Sub-Total	Small	Medium & Large	Sub-Total	Small	Medium & Large	Special	Sub-Total	Small	Medium & Large		
Total	6,786.2	3,605	272	17	255	2,236	269	1,634	33	81	40	41	834	182
7- 8	446.4	218	17	1	16	134	41	90	3	11	5	6	42	14
8- 9	507.7	295	27	4	23	169	42	124	3	12	6	6	70	17
9-10	566.5	302	21	1	20	187	44	138	5	3	1	2	71	20
10-11	605.3	322	24	1	23	204	54	149	1	3	1	2	73	18
11-12	616.0	326	27	2	25	201	52	145	4	9	5	4	74	15
12-13	577.2	309	22	1	21	190	47	142	1	6	3	3	74	17
13-14	594.7	316	27	1	26	192	47	144	1	8	5	3	72	17
14-15	574.7	303	21	1	20	193	48	142	3	4	2	2	73	12
15-16	576.5	306	22	1	21	189	47	138	4	7	3	4	73	15
16-17	583.5	309	21	2	19	194	47	145	2	9	5	4	70	15
17-18	589.3	311	22	1	21	199	54	140	5	5	2	3	72	13
18-19	548.4	288	21	1	20	184	46	137	1	4	2	2	70	9

* Passenger Car Unit

(Anyang → Seoul)

Unit : Vehicle trip/day

Survey Hour	Total		Bus			Lorry				Military Car			Passenger Car	Two-wheel-Vehicle
	Total of P.C.U.*	Total	Sub-Total	Small	Medium & Large	Sub-Total	Small	Medium & Large	Special	Sub-Total	Small	Medium & Large		
Total	7,216.6	3,797	296	16	280	2,330	513	1,796	21	97	48	49	888	186
7- 8	411.0	222	18	3	15	134	35	98	1	6	3	3	49	15
8- 9	509.6	276	22	1	21	173	43	129	1	11	5	6	59	11
9-10	590.8	315	22	1	21	193	41	150	2	7	6	1	75	18
10-11	639.1	333	25	1	24	209	43	164	2	9	6	3	74	16
11-12	620.0	326	22	1	21	201	43	157	1	9	3	6	79	15
12-13	612.0	319	25	1	24	195	38	156	1	7	2	5	77	15
13-14	635.3	335	21	1	20	198	45	152	1	19	4	15	84	13
14-15	616.0	323	25	2	23	198	36	160	2	5	4	1	80	15
15-16	643.5	334	24	1	23	202	43	156	3	4	2	2	79	25
16-17	643.7	341	23	2	21	211	46	161	4	9	6	3	81	17
17-18	662.4	345	29	1	28	217	50	166	1	8	5	3	77	14
18-19	633.2	328	40	1	39	199	50	147	2	3	2	1	74	12

SOURCE : The Ministry of Construction and the Korea National Housing Corporation, Gwachon New Town Development Plan and Design : The 1st Stage Report,

* Passenger Car Unit

According to an intra-region traffic survey, there were 6,786 vehicle trips/day(P.C.U.) from Seoul to Anyang and 7,216 trips/day (P.C.U.) from Anyang to Seoul. Peak-hour traffic amounted to 616 vehicle trips (from 11:00 a.m. to noon) from Seoul to Anyang and to 662 vehicle trips (from 5:00 p.m. to 6:00 p.m.) from Anyang to Seoul.

Although the transportation facility was adequate to meet the transportation needs of that community at that time, there were serious traffic impacts such as vibration, noise, air pollutants and traffic accidents.

61 percent of the trips passing through the Gwachon area were travels by lorries and 23 percent by passenger cars.

b. Impact Assessment :

A recently accepted method of capacity analysis was selected for our studies because road traffic capacity has been the most important indicator to evaluate the adequacy of the transportation facility.

Table 37. presents the basic traffic capacity criteria based on field surveys in Korea.

Table 37. Basic Traffic Capacity (C_B) 1/

(unit : PCC (Passenger Car Conversion))

Lane	Local	Urban
Multi-lane	2,300 per lane	2,500 per lane
Two lances-two ways	1,150 per lane	1,250 per lane
Three lanes-two ways	2,350 per lane	2,500 per lane

1/ The Ministry of Construction, A Study on the Calculation of Road Traffic Capacity, Seoul, 1981.

According to Table 36, the central main road was passed over by 1,252 passenger cars/h (from 5:00 p.m. to 6:00 p.m.). This traffic volume was within the 2,500 passenger cars/h(urban) capacity of the road recommended by the Ministry of Construction.

Table 38 shows the daily traffic volume on the central main road in Gwachon surveyed in 1982.

Table 38. Traffic Volumes after Completion of Phases I and II and Part of the 2nd Government Hall.
(From 9:00 a.m. to 7:00 p.m. 26 March, 1982)

unit : Passenger Cars

Hour / Classification	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19
Seoul-Anyang	1,075	1,426	-	1,330	1,264	1,481	1,785	1,788	1,265	-
Anyang-Seoul	1,235	1,194	1,219	1,175	1,143	1,470	1,378	1,345	-	1,592
Average	1,155	1,310	1,219	1,252	1,203	1,475	1,581	1,566	1,265	1,592
Total	2,310	2,620	2,438	2,504	2,406	2,950	3,162	3,132	2,530	3,184

SOURCE : Based on traffic counts furnished by the Korea National Housing Corporation

As we can see in Table 38, the average daily traffic volume with regard to passenger cars amounted to 27,236 at this road in March 1982. This traffic volume means a doubling of the 1978 figure. Peak-hour traffic increased to 3,184 passenger cars in March, 1982. (completion of Phases I and II and part of the 2nd Government Hall).

For passenger cars per hour, 3,184 passenger cars passed over this road from 6:00 p.m. to 7:00 p.m., 26 March, 1982. This traffic volume was well above the 2,500 passenger cars/h(urban) basic capacity(C_B) of the road. The main road has already exceeded its capacity.

There are serious consequences which impact the community since the transportation facilities are inadequate to meet the transportation needs of that community. The resulting congestion means wasting of time and

energy, produces excess air pollutants and noise (see the sections of air quality and noise). Unless the planned by-pass road is allowed to be constructed soon, the traffic congestion can have adverse effects on the land uses themselves. A major element of the master development plan is the planned improvements of roads. The program specifies the widening of the central main road and construction of one by-pass road. It is apparent that the traffic impacts will be significantly reduced if the road program is implemented in time.

The social survey conducted by the author reveals that the traffic means of employed residents who work elsewhere depends heavily on the public transportation system. 292 out of 431 'employed residents who worked elsewhere', i.e. 68 percent, used inter-city buses (Table 39).

Table 39. Mode of Transportation Used by Employed Residents Who Worked elsewhere.

	No.	%
Inter-city bus	292	68
Company operated free bus	108	25
Taxi	5	1
Passenger Car	24	5.6
No reply	2	0.4
	431	100

On the other hand, 57 out of 59 'students who traveled out of the town, i.e. 97 percent, used inter-city buses. In general, for residents living in the town, busing is the most popular mode of transportation to other areas including Seoul city.

According to the social survey, residents of the new town appear for the most part dissatisfied with the town's public transportation system.

Table 40. Satisfaction with the Town's Public Transportation System

	No.	%
Very satisfied	3	0.8
Satisfied	22	5.8
Neither satisfied nor dissatisfied	130	34.1
Dissatisfied	163	42.8
Very dissatisfied	59	15.5
No reply	4	1.0
	381	100

In part, the inadequacy of transportation in the new town is due to the infrequent bus service and fare differences relative to the administrative district of the town.

Buses which serve the Gwachon community include the 90 route (standing bus), the 97 route (standing bus), the 86 route(standing bus), the 90 route (seat bus), the 797 route (seat bus), the 10 route (inter-city bus between Suwon and Seoul(Chunho-Dong), the 1 route (inter-city bus between Sadang-Dong and Anyang), and the 11 route (inter-city bus between Suwon and Seoul (Yongsan))

In addition to the bus routes, the 2nd Government Hall is also served by Government operated free buses. It is difficult to say that more government employees will live closer to the 2nd Government Hall as the town matures which would in turn influence the primary mode of transportation in the area.

According to the consultant's estimation, the proposed project (14,200 units) would generate 3,095 vehicle trips per day.

Traffic associated with the Gwachon development will heavily impact some routes within Seoul. For example, the road between Dongjak-Dong National Cemetery and Sadang-Dong Rotary is too narrow and winding for the combined traffic flows of existing and future transportation needs, particularly due to the 2nd Government Hall activities, and hence causes lengthy delays. The widening of the road is planned to be 50 m to meet transportation needs of the road (Figure 15). Other likely impacted routes should be monitored in terms of traffic flows during construction and after completion of the new town development project.

A bicycle road, 2,650 m in length, i.e. 8.6% of all transport, is proposed for the town. Additional bicycle roads, 990 m long, would be necessary to link the whole town by a cycle network (Figures 16, 17 & 18). With an increase from 2,650 m(8.6%) to 3,640 m (11.8%), an improvement of accessibility could be significant. Extra costs for the additional cycle roads would be valued as Won 4,774,000.-

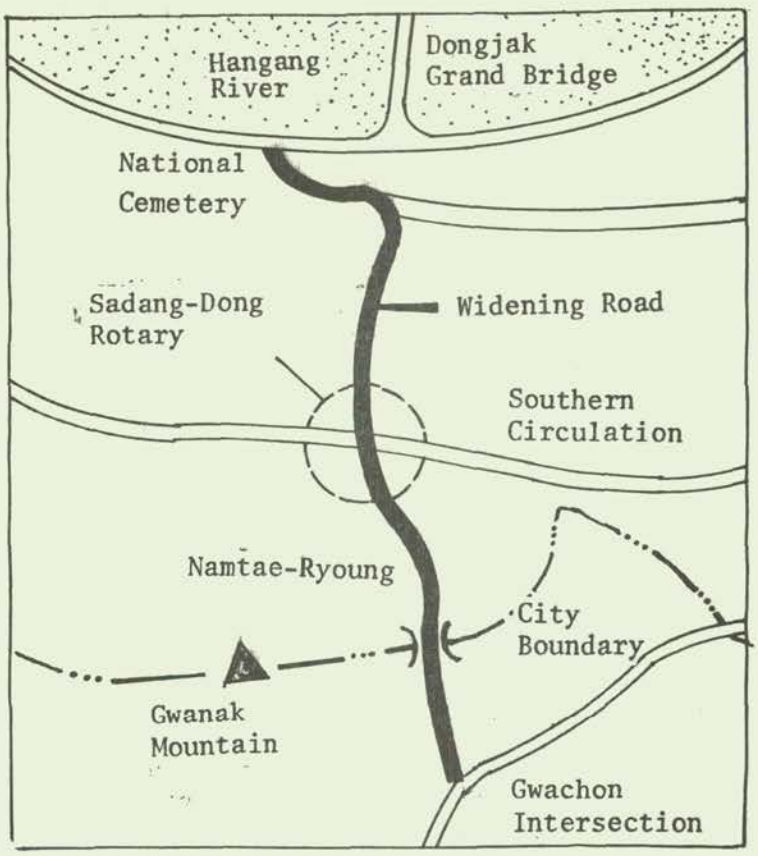


Figure 15. Regional Circulation between Dongjak-Dong National Cemetery and Gwachon Intersection

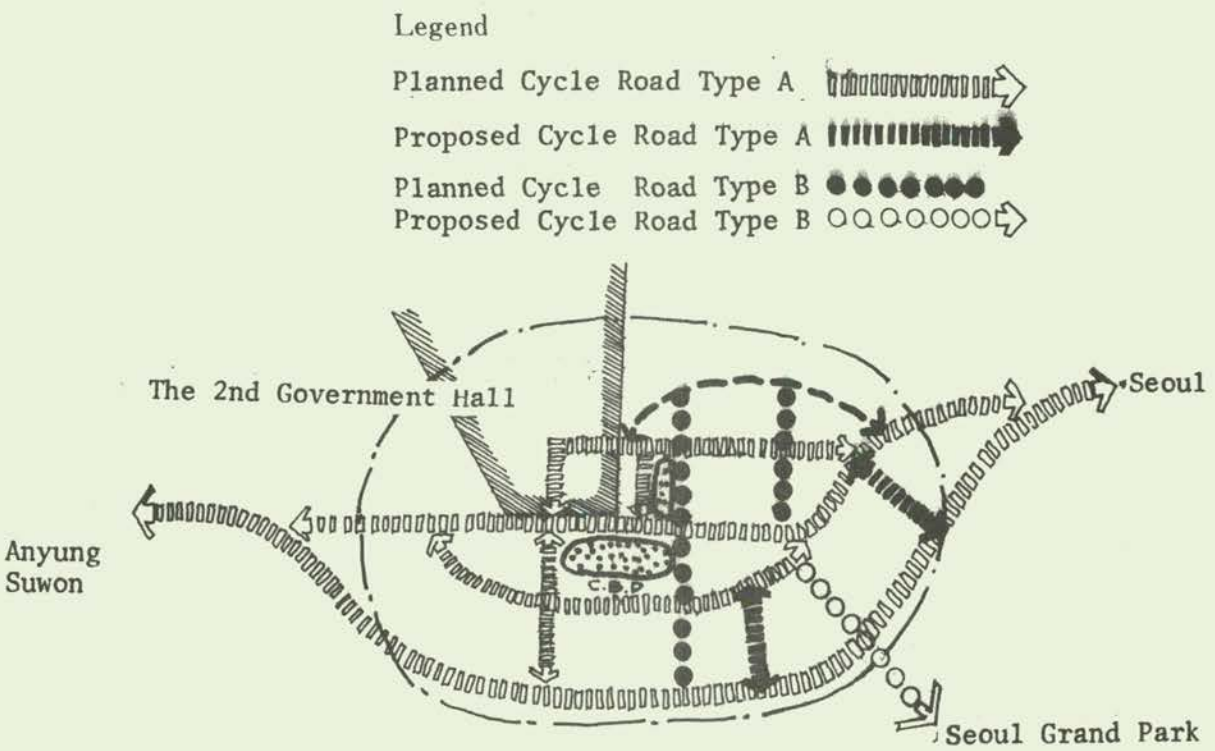


Figure 16. Planned and Proposed Cycle Network

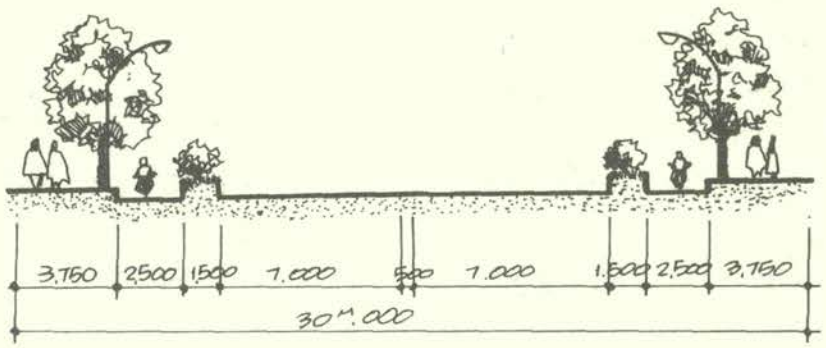


Figure 17. Cycle Road Type A

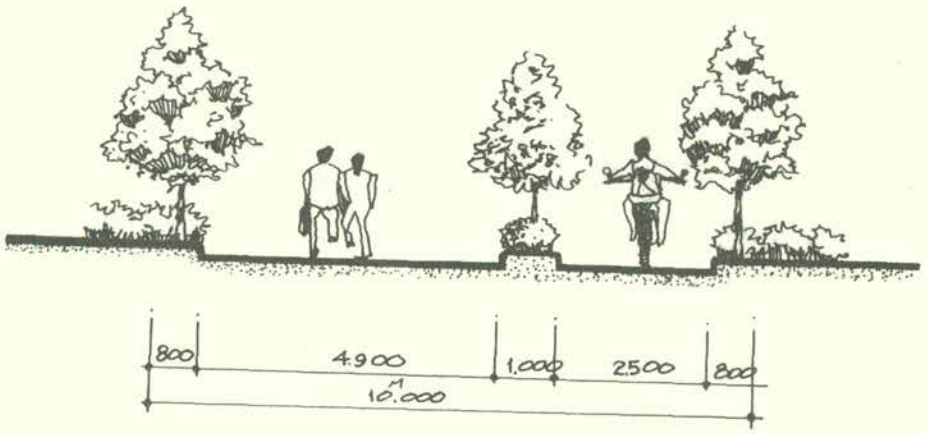


Figure 18. Cycle Road Type B

C. Mitigation Measures :

(1) Measures incorporated into the design of the project by the developer

- Traffic service to the site is provided by the central main road, a four-lane divided roadway (3,450 m; 30 m) and a by-pass road (5,050 m; 50m) in order to relieve the heavy burden placed upon the existing main road. The widening work of the central main road would cost Won 5,700,149 thousand and construction of the by-pass road Won 19,158,164 thousand.
- Development of bicycle and pedestrian systems to provide access to nodal community structures(school, centres, etc.) and to encourage lower car use in order to conserve energy. The planned cycle road is 2,650 m. The construction cost of it would be Won 12,778,000.-

(2) Other measures that could be incorporated:

- Extension of cycle road to link the whole town by a cycle network. The cost would be valued as Won 4,774,000.-
- To minimize overall traffic impacts, control growth in surrounding area.
- Traffic signal controls be installed on site for new movers, although only part of the project has been completed at the present time.
- The widening work of the central main road and construction of the by-pass road should be completed as soon as possible since it has already exceeded its capacities.
- An efficient traffic management be introduced since the proposed project will contribute to the cumulative effects of increased traffic in the Seoul Metropolitan region.
- The role of public transport be expanded.

4. Demography and Community Identity

a. Environmental Setting : The town development destroyed the "rural character" of the area and forms new urban environment. The physical and socioeconomic characteristics of Gwachon before the project have been described elsewhere in this study.

b. Impact Assessment : In this area, a significant disruptive effect can be caused by the removal of homes which are direct results of the project. The demography and community identity impact resulting from transformation of rural residential areas to urban residential areas is critical. The new town development project increased the population from 6,840 in 1978 to 22,497 in October 1982 (Completion of phases I and II).

The project site is still under development. It is, therefore, extremely difficult to describe and assess the future demographic characteristics and community identity of the whole new town. For this reason, we have approached the issue of demography and community identity of the publicly developing new town by conducting a limited social survey of the households which have already moved into the Gwachon new town. On the basis of the sample survey data which can be found in appendix II, it is possible to summarize the socio-economic characteristics and life styles of the community. This information may be used to evaluate the prediction and assumptions established in the preparation of the Gwachon New Town Development plan.

The majority of Gwachon residents share a favourable view of the town, and image characterized by pleasantness of residential areas and new houses and visual attractiveness of urbanscape (Tables 41, 42 & 43).

Gwachon appears, however, to be a town whose populace resists the image of a small independent country town and tends to emphasize instead to be part of a metropolitan suburb. 1/

In our opinion, the explanation has little to do with the physical characteristics of the town, though the significance of the suggestion will have to be considered, that the comparative absence of friction between the new town and the existing village of Gwachon was due to the smallness of the older community. Much more important are, first of all, the factors that resulted in people coming into Gwachon and second, the attitude and life style of the Gwachon residents.

1/ Here it may be worth noting that the proposed new town is being constructed at the southern part of Metropolitan Seoul which is within the Seoul City Planning Area.

Table 41. Pleasantness of Residential Environment

	No.	%
Very pleasant	62	16
Pleasant	218	57
Neither Pleasant nor unpleasant	81	21
Unpleasant	13	4
Very unpleasant	4	1
No reply	3	1
	381	100

Table 42. Satisfaction with a New House

	No.	%
Very satisfied	15	4
Satisfied	116	30
Neither satisfied nor dissatisfied	141	37
Dissatisfied	95	25
Very dissatisfied	11	3
No reply	3	1
	381	100

Table 43. Visual Attractiveness of Urbanscape

	No.	%
Very beautiful	23	6
Beautiful	140	37
Neither beautiful nor ugly	178	47
Ugly	28	7
Very ugly	5	1
No reply	7	2
	381	100

Very roughly, the lines along which this exploratory stages of the investigation have been conducted are as follows :

(1) Sociability Characteristics

The proposed project is expected to directly change the existing demographic composition of Gwachon. Indirectly, the project may affect

the demoraphic composition of the surrounding community by stimulating economic activity.

As of 10 January 1983, Gwachon contains a population of approximately 24,442 people, a figure which represents about 38.80 percent of the target population(6,300 people) of the Gwachon new town.

The social survey showed that 79 percent of the labour force in Gwachon is in, broadly, white-collar employment(white-collar office jobs such as Government officials, school teachers, technical experts, company staff and clerks) (Table 44).

Table 44. Occupation Characteristics

	No.	%
Clerk	170	36
Government official	102	21
Commerce	57	12
Technical expert	48	10
School teacher	42	9
Company staff	16	3
Technician	10	2
Agriculture	3	1
Manual worker	1	-
Other	22	5
No reply	4	1
	475	100

Broady's study of the sociology of the urban environment, in 1970,[1/] stated that :

" ... the general sentiment that Harlow is a particularly lively town, socially, though by no means conclusive evidence, is sufficiently widespread not to be ignored .... As for the first set of factors, it is now well established that the incidence of social initiative and

1/ Broady, M., The Sociology of The Urban Environment, Ekistics, Vol. 172, March 1970, pp. 187-190.

community leadership is proportionately higher among white-collar than among manual workers. Therefore, hypothetically, the high level of social vitality which has been noted in Harlow might well be associated with a higher proportion of white-collar employment than in other new towns, and thus with the town's industrial selection policy."

Here in Gwachon, we have used social contact as an indication of socialization and neighbourhood cohesion. We found that, although the method has serious weaknesses due to its high degree of aggregation of variables, the low level of sociability exists in the new neighbourhood.

Table 45. Social Contact with Neighbours

	No.	%
Contact so many people	8	2
Contact many people	49	13
Contact several people	250	66
Don't contact any person	52	14
Don't know	22	6
	381	100

The lack of friendliness resulted possibly from a number of reasons, specifically from the combined effects of more young families living in the apartments, the life style being more likely to spend much time together with their own families, the general trend towards more in-house cultural facilities usage, and Gwachon's housing policy which results in a small portion of countrified houses. It would be, therefore, difficult to relate a higher proportion of white-collar employment directly to a greater incidence of social vitality even after completion of the new town development. Broady(1970) has also stated that among the social activists in Harlow, England, the teachers are said to have played a particularly important role.

6 million people will be employed during the 5 year construction phase of the Gwachon project. The demographic impact of the construction related work is therefore considered significant.

(2) Household Characteristics

The proportion of elderly residents (over the age of 59) and children (under the age of 5) is almost 1:4. Gwachon households tend to have a higher proportion of children and reflect greater instability.

According to the Gwachon General Plan, household characteristics would be as follows (Table 46).

Table 46. Composition of Households Based on the Gwachon General Plan

Type	'81		'83		'85	
	Household	%	Household	%	Household	%
Total	6,054	100	10,159	100	11,308	100
Enlarging	805	12	1,300	13	1,391	12
Normal	2,621	44	4,551	45	5,247	47
Shrinking	2,628	44	4,308	42	4,670	41

In this table, it was predicted that the normal household type with greater stability would increase due to in-migration of government officials and their families. However, the sample survey results from 26 December 1982 to 10 January 1983, showed that the proportion of the enlarging household type is rather higher than the normal and shrinking household type(Table 47). More young families are said to have played a particularly important role, though the implications of this for the social structure are not clear at present.

Table 47. Composition of Households Based on the Sample Survey

Type	Number	%
Total	381	100
Enlarging	190	50
Normal	52	14
Shrinking	139	36

The sample survey indicated that the average number of persons per household is 3.8. This figure is smaller than for the country as a whole, and appears to be due to more young families whose structure and life style are becoming nuclear families. In addition, the reduction of the number of children per family through family planning plays an important role.

(3) Age Characteristics

The sample survey indicated that 57% of the sample population was between the age of 20 and 59, and 48% between 20 and 39 years. (Table 48.)

Table 48. Age Characteristics

Age Group of Residents	No.	%
Under 5	303	21
5 - 11	149	10
12 - 19	86	6
20 - 29	343	24
30 - 39	352	24
40 - 59	133	9
60 & Over	73	5
No reply	3	1
	1,442	100

(4) Education Characteristics

44% of sample residents attended university, and 8% college (two-year course) (Table 49).

Table 49. Education Characteristics

Type of School	No.	%
Did not attend school	28	3
Primary School	132	13
Junior High School	74	7
Senior High School	189	19
Technical College(Two year course)	82	8
University	442	44
No reply	60	6
	947	100

(5) Housing Characteristics

209 out of 381 households, i.e. 55% lived in Gwachon for more than seven months. 283 of 381 households, i.e. 74% are owner-occupied.

(6) Economic Characteristics

Of the sample population of 1,442 of Gwachon, 475, i.e. 33%, are in the labour force. Of the 475 employed residents aged fourteen or older, 73% are male and 27% female. The proportion of the female employees is higher than the nation-wide average, and appears to be mainly due to the higher level of eduction of the female population.

The income level for some 70% of the 381 sample households was over Won 300,000. Those people whose income was less than Won 100,000 may have another source of income, including financial assistance from parents and relatives. (Table 50)

Table 50. Family Income Characteristics

Income Group(Won)	No.	%
Under 100,000	4	1
100,001 - 200,000	11	3
200,001 - 300,000	70	18
300,001 - 400,000	89	23
400,001 - 500,000	80	21
500,001 & Over	98	26
No reply	29	7
	381	100

Despite the failure of a balance between employment and population in terms of self-containment, the majority of Gwachon residents strongly resists attracting industries to the area (Table 51).

Table 51. Creation of Employment Opportunities by Attracting Industries

	No.	%
Strongly support	6	2
Support	16	4
Neither support nor oppose	71	19
Oppose	131	34
Strongly oppose	157	41
	381	100

As previously discussed, the attitude survey result shows that the source of residents' satisfaction has for the most part to do with the physical environment of the town and a new house. Furthermore, in general, the residents share favourable views on tax payment for environmental improvement (Table 52).

Table 52. Tax Payment for Environmental Improvement of the Area

	No.	%
Will not pay	32	8
Will pay, if small	115	30
Will pay as much as I can	209	55
Will pay the same amount as the Government ask	18	5
No reply	7	2
	381	100

Major complaints have to do with the increased cost of this environment and lack of government concern (Tables 53 and 54), and the inadequacy of public transportation (see also the section of transportation).

Table 53. Cost of Living in the Area

	No.	%
Very expensive	61	16
Expensive	189	50
Neither expensive nor cheap	110	29
Cheap	16	4
Very cheap	0	0
No reply	5	1
	381	100

According to the survey results, in the new town the new inhabitant have tended to be critical of authority and political concerns. Although the press has carried many stories of the Gwachon development, new town residents complained about the lack of government interest in development matters.

Table 54. Degree of Government Interest and Concerns

	No.	%
Concerns too much	10	3
Need no more concerns	6	1
Adequate concerns	68	18
Need more concerns	141	37
Need much more concerns	145	38
No reply	11	3
	381	100

After the construction of the second Government Hall, in order to disperse administrative functions agglomerated in downtown Seoul and population in the Seoul area, Gwachon will become an administrative supporting new town. It is anticipated that the 2nd Government Hall will be part of the surrounding community and as such will influence it. It is, however, difficult to say that despite special efforts to provide houses for government employees who work or will work in the 2nd Government Hall, a large portion of them would move into Gwachon. The 2nd Government Hall will provide direct employment, white collar office jobs for

5,000 people who transfered/will be transfered from the 1st Government Hall. Thus, the 2nd Government Hall does not contribute directly to the economic base of the town. Exceptions may be indirect impacts on the service sector, the land and property value of the site and the surrounding areas.

At the time of the site clearance, the family graves on the proposed site, i.e. 231 graves, were destroyed and removed to other areas. In addition to the compensation for the land, the extra cost of grave removal from the site is valued at Won 11,415,000.

To assess the level of cultural facilities owned by households, we have used the national figures as a standard of comparison(Table 55). According to the survey conducted by the author, in terms of the level of cultural facility ownership, the standard of living of Gwachon is much higher than that of the nation as a whole.

Table 55. Ownership of Cultural Facilities

Cultural Facilities	Gwachon Sample Survey (%)	1980 Population and Housing Census (%)
TV	98	87
Refrigerator	97	38
Washing Machine	67	11
Telephone	35	24
Newspaper	97	40
Piano. Organ	16	4
Room Aircon.	3	1

Finally, the actual turnover rate of residents for the Gwachon new town appears high. The high turnover rate of the new town residents does not directly indicate dissatisfaction with life in the new town but the presence of an adequate opportunity for the speculative housing market. This would have an adverse impact on the community stability. At present, the transfer of houses and private rental housing does present particular difficulties of turnover rate analysis because of the varieties of sales and rent regulations and controls.

c. Mitigation Measures :

(1) Measures incorporated into the design of the project by the developer:

- House sales be prohibited within six months from the purchasing date as a part of measures against frequent turnover of houses.

- Compensation be made in order to relieve the community sentiment caused by the loss of family graves. The cost of it would be valued as Won 11,415,000.

(2) Other measures that could be incorporated :

- The site is within the Seoul city planning area, but within the jurisdiction boundary of Gyonggi Province. Some kind of combined effort would be necessary.
- An extensive, long-term association between the 2nd Government Hall and Town would be necessary to plan government-community relations together for their mutual benefit and "community spirit". This effort would make the 2nd Government Hall an even more integrated part of the community of which it is a part.
- Desires of newcomers vary according to age, class, and life style. Physical plans must be flexible to allow for adaptation to change as time and demand vary. Social assumptions of planners concerning neighbourliness, convenience, and accessibility of amenities may have to be re-examined (See the section of "Recreation and Parks" for accessibility of amenities).

For example, we found that the proportion of enlarging households is higher than that based on assumptions of planners. Therefore, some provisions of housing for enlarging households should be made since the amount of the new town housing to be allocated to second-generation families will undoubtedly increase as the Gwachon new town matures.

5. Recreation and Parks

a. Environmental Setting :

The Gwanak Natural Park, 20,591,224 m^2, surrounds the north and east sides of the proposed development, and the Chyongge Natural Park the south and west sides. These areas are primarily used for hiking trails. Several camping grounds are in the area.

The Seoul Grand Park is approximately four kilometres southeast of the site. The Seoul Grand Park development was started in 1978. During the period from 1978 to 1986, approximately 5,313,000 m^2 will be developed to serve 630,000 people (on sundays when completed in 1986) of Seoul and the surrounding communities. Facilities available at the sites include an aboretum, a zoo, youth-cultural facilities (youth-centre, recreation centre, science building, youth-hostel) and recreation facilities (aerobus, cable car, folk customs contest area, etc.). Some facilities will be available to the general public by October 1983.

b. Impact Assessment

Vest pocket parks(4), play lots(35), neighbourhood parks(2), tennis courts(4) and town park(1) are proposed for the Gwachon new town development(see Gwachon's urban open space system 471,900 m^2).

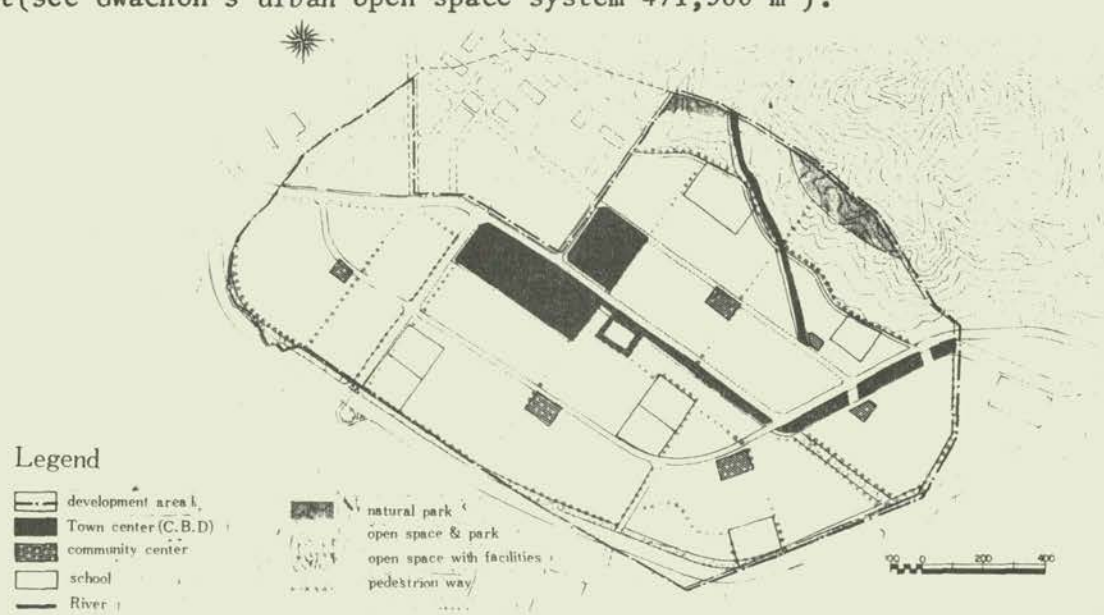


Figure 19. Gwachon's Urban Open Space System

In-house recreational facilities, including recreation rooms, swimming pools, etc., have been proposed for the project.

With an increase of 6,840 to 63,000 persons the impact could be significant because there were no existing facilities within the proposed project site.

The amount of park and recreational land use within the project area may be described in terms of the number of acres (or square feet or other units) per given unit of population (e.g. acres/1,000 persons). Since the impact of the project on the area population is known, the impact of the project on park and recreational land use may be described in terms of the additional land that would be necessary to meet recommended area/population ratios. In addition, the quality of park and recreational facilities may be taken into consideration based on the social survey conducted by the author.

In practice, park standards for adequate community recreational opportunities are consulted in the evaluation of these impacts comparing projected area ratios with established standards. Since many possible standards of neighbourhood or community quality could be devised, the method using ratios of various types and/or intensities of park and recreational land use to area population represents only one possible approach to the problem of evaluating possible impacts of the development project on the park and recreational land use within the area.

In this study, we have used the standards established by the U.S. National Recreational and Park Association(Table 56) in order to evaluate anticipated impacts on recreational land use activities from the proposed project. Such comprehensive standards for adequate community recreational opportunities are not available in this country. There are no new town development standards enforced by code.

Table 56. Park Standards by Type and Population Served.

Classification	Acres/1,000 People	Size range	Population Served	Service Area
Play lots	N.A.	2,500ft^2 to 1 acre	500 - 2,500	Subneighbourhood
Vest Pocket Parks	N.A.	2,500ft^2 to 1 acre	500 - 2,500	Subneighbourhood
Neighbourhood Parks	2.5	Min. 5 acres up to 20acres	2,000-10,000	¼ - ½ mile
District Parks	2.5	20 - 100acres	10,000-50,000	½ - 3 miles
Large Urban Parks	5.0	100$^+$ acres	One for each 50,000	within ½ hr. driving time
Regional Parks	20.0	250$^+$ acres	Serves entire pop. in smaller communities ; should be distributed throughout larger metro areas	within 1 hr. driving time.
Special areas and facilities	N.A.	Includes parkways, beaches, plazas, historical sites, flood plaines, downtown malls, and small parks, tree lawns, etc. No standard is applicable.		

SOURCE : Quoted from Rau and Wooten, 1980, P. 2-13. 1/

An evaluation of anticipated impacts on recreational land use activities from the new town development project is given in the following:

(1) Town Playground Space

- Target population of the proposed project is 63,000 persons. Town quality standards for adequate playground facilities are as follows

  28,350 m^2 (63,000 ÷ 2,500 x 1,125 m^2)

  1.125 m^2/2,500 population

- Proposed playground facilities are

  32,310 m^2

  1,282 m^2/2,500 population

Therefore, proposed playground facilities are adequate.

1/ Rau, J.G., Socioeconomic Impact Analysis in Rau, J.G. and Wooten, D.C(eds.), Environmental Impact Analysis Handbook, McGraw-Hill Book Company, New York, 1980, P 2-13.

(2) Vest-Pocket Park

- Target population of the proposed project is 63,000 persons.
  Recommended vest-pocket park standards are 28,350m^2 of park space
  (63,000 ÷ 2,500 x 1,125 m^2) 1,125m^2/2,500 population
- Proposed vest-pocket park is
  13,150 m^2
  521.8 m^2/2,500 population

Therefore, to meet recommended standards, an increase of 15,200 m^2 would be required.

(3) Neighbourhood Park

- Target population of the proposed project is 63,000 persons. Neighbourhoods standards recommended by U.S.N.R.P.A are
  509,896.8 m^2 of park space (63,000 ÷ 1,000 x 8,093.6 m^2)
  8,093.6 m^2/1,000 population
- Proposed neighbourhood park space is
  67,000 m^2
  1,064 m^2/1,000 population

Therefore, to meet recommended standards an increase of 442,896.8 m^2 would be required.

On the other hand, if we use neighbourhood park standard recommended by the "Guidelines for the Preparation of City General Plan of Korea" are as follows :

- Target population of the proposed project is 63,000 persons.
  Recommended neighbourhoods standares are
  75,600 of park space (63,000 ÷ 1,000 x 1,200 m^2)
  1,200 m^2/1,000 population (1991 standard)
- Proposed neighbourhood park space is
  67,000 m^2
  1,064 m^2/1,000 population

Therefore, to meet recommended standards an increase of 8,368 m^2 would be required.

(4) Town Park

- Target population of the proposed project is 63,000 persons.
  Recommended standards of a town park are
  509,896.8 m^2 of park space (63,000 ÷ 1,000 x 8,093.6 m^2)
  8,093.6 m^2/1,000 population
- A proposed town park space is
  476,000 m^2
  7,555 m^2/1,000 population

Therefore, to meet recommended standards an increase of 33,896.8 m^2 would be required.

(5) Regional Parks

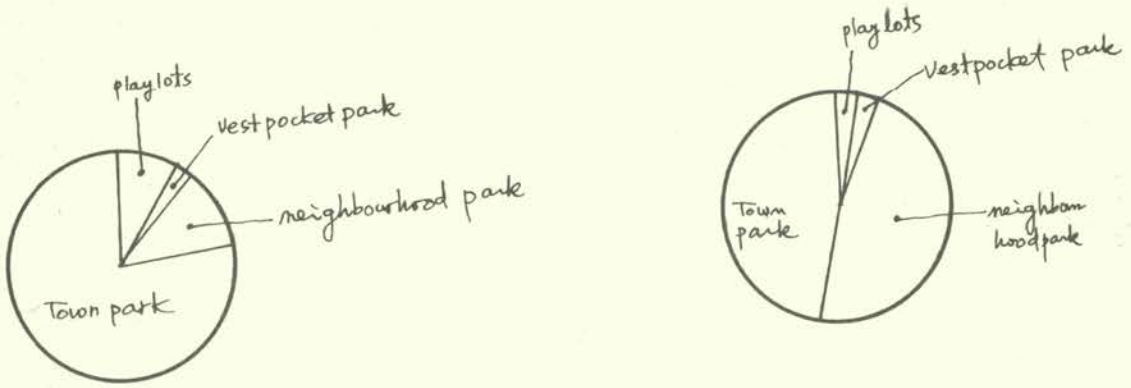
The developing Seoul Grand Park is adequate enough for serving entire population in the Gwachon new town.

Table 57 presents a summary of evaluating the possible impacts of the development project on area recreational land use patterns.

Table 57. Summary of Evaluations : Overall Comparison

Classification	Gwachon Development Plan		U.S.N.R.P.A		Guideline for City General Plan		Evaluation
	Area(m^2)	(%)	Area(m^2)	(%)	Area (m^2)	(%)	
Playlots	32,310	6	28,350	3	-	-	+ 3,960/m^2
Vest-Pocket Park	13,150	2	28,350	3	-	-	- 15,200 m^2
Neighbourhood Park	67,000	11	509,896.8	47	75,600		o Based on U.S.N.R.P.A -442,896.8 m^2 o Based on the Guideline for City General Plan -8,600 m^2
Town Park	476,000	81	509,896.8	47	-	-	-33,896.8 m^2
Total	588,460	100	1,076,493.6	100	-	-	o Based on U.S.N.R.P.A -488,033.6 m^2

Figure 20 shows the same information on the structure of the park system in graphical form.



Based on Gwachon Development Plan

Based on U.S.N.R.P.A

Figure 20. Overall Comparison of the Park System

We have estimated that provisions of additional parklands based on the above analysis would cost Won 1,690 million for 488,000 m^2 of park space and Won 18,241,000 for 8,600 m^2, respectively.

Assessing service areas in each park would be another possible approach to the problem of evaluating possible impacts of the proposed development project on the mix of land uses within the area. This means that the impact of the project on recreation land use can be described in terms of social equity. Although the proposed park space appears somewhat inadequate within the town site itself, Gwachon has had the fortune to be a park-like setting with the Gwanak and Chyongge Natural Parks surrounding the town. Thus, many people live within reasonable distance from those parks.

The social survey reveals that 137 out of 381 respondents, 36%, appear, however, to have unfavourable views on park facilities in the area.

c. Mitigation Measures :

(1) Measures incorporated into the design of the project by the developer.

- 588,460 m^2 of park space should be provided to meet the need for recreational opportunities.

(2) Other measures that could be incorporated.

- An additional 8,600 m^2 of park space would be necessary to meet standards recommended by the guidlines for the Preparation of a City General Plan. It would cost approximately Won 18,241,000. The establishment and enforcement of a new town act may assist in meeting the need for additional recreational opportunities.
- The unbalanced structure of the proposed park system should be rectified to offer equal recreational opportunities for each family.

6. Visual/Aesthetic/Attractiveness

a. Environmental Setting :

The proposed site is divided into two parcels by the road which crosses the site in southwest-northeast direction. The central canal remains as open space and provides water to Gwanak's agricultural lands.

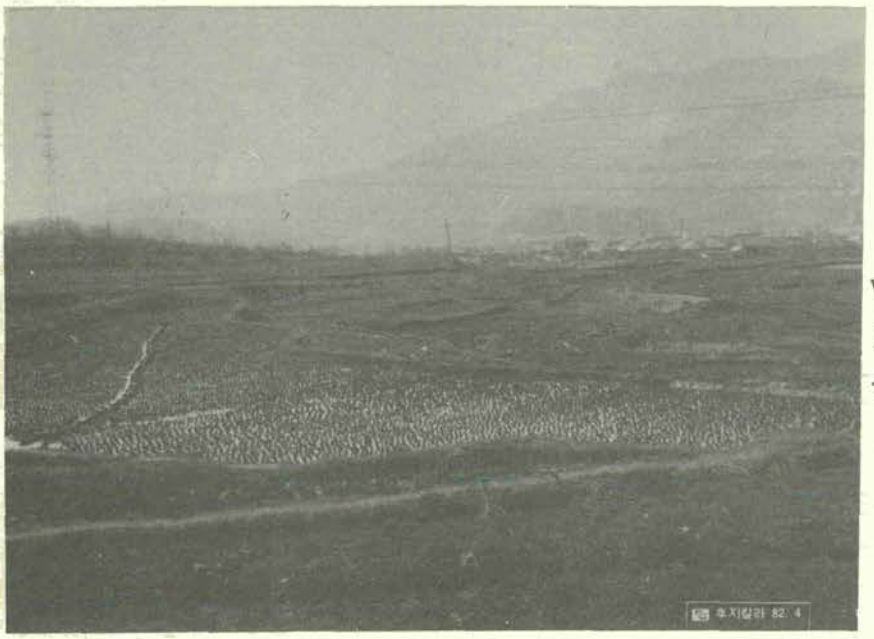
Views from the site are generally mountainous. Gwanak Natural Park presents dynamic characteristics in contrast to Chyongge Natural Park revealing static aspects, but both of them form prominent mountain landscape features. The site also possesses a confucious school and a lake to be important objects of landscaping for constructing neighbourhood parks.

Further developments may be anticipated in the future to complete the transition from open space to urban uses in the areas between Gwachon and the fringe of Seoul city.

b. Impact Assessment :

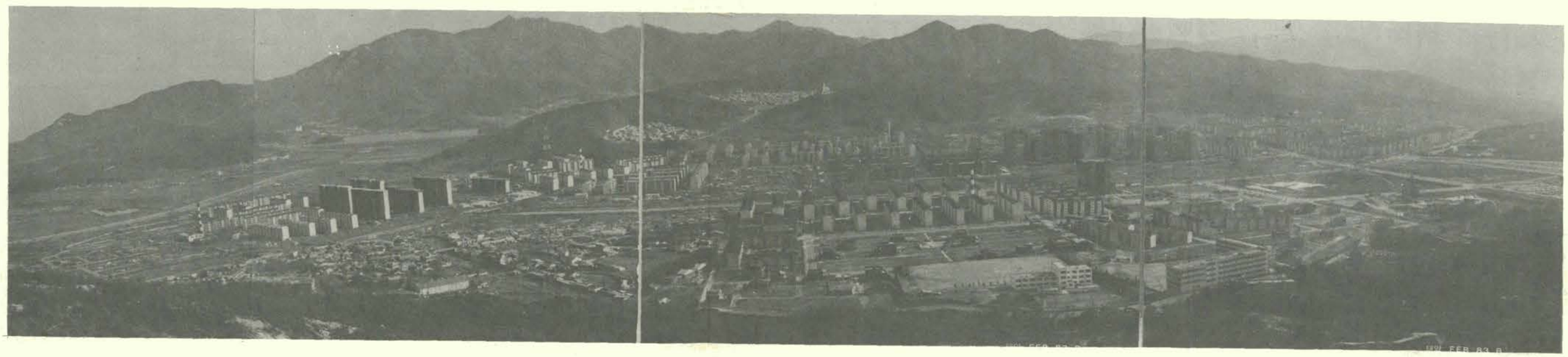
The term "Visual Pollution" has been coined to describe the aesthetic impacts of a project. In this area, the aesthetic impacts of the project result both from the addition and removal of structural improvements and from alterations of land forms, existing vegetation, and streams.

The rural landscape has been changed into the urban landscape which primarily consists of hardscape (i.e. pedestrian walks, parking) and landscaped areas (i.e. trees, shrubs, ground covers and lawns). The following photos include a view before development, a view during construction and view after completion of part of the project.



View of agricultural lands before the new town project.

View of the site and site-adjacent segment. This represents its existing and impacted conditions.



View of the site under construction. The majority of the site is presently developed. One part of the existing village on the left will be displaced shortly. The high-rise apartments, i.e. 14 & 15 storeys, destroy skyline cohesion with the adjacent apartmentscape and valleyscape.

The majority of site grading has been done and some more will be required for the fourth stage development area to provide structures and buildings, road and other access. Moreover, parking facilities will be developed. The adverse visual impact of the grading operations will be temporary and relatively short-term in nature, as the site will be landscaped with trees, shrubs and grass. According to the Project Landscape Architect, the estimates for current landscaping costs are Won 3,600/m^2 for apartment areas, Won 9,000/m^2 for a central city park and Won 15,000/m^2 for community centres.

The Architectural Law of Korea requires that 15 percent of the whole site area should be landscaped. In this area, 35 percent of the new town site (the 2nd Government Hall site excluded) will be covered with lawns. The number of new trees planted will be more than the trees removed.

As a result of the proposed central plaza park (i.e. a town park) along the existing central canal, the aesthetic and functional characteristics of the total urban environment would be significantly improved. It would require Won 418,650,000 for construction.

Landscape plantings (especially trees) serve purposes other than aesthetics in the urban environment. Plantings aid in reducing reflection and glare, diffusing noise (acoustical control) and light originating from within the project, and to some extent, control temperature, air movement, and diffusion of automobile emissions in the parking areas.

Considering the reality of the Gwachon General Plan designating high density residential development, it may be stated that the open space use, anticipated by the development of park and recreational facilities, will provide a sense of relief from the structural harshness and coldness associated with the intensive urban development. The mere naturalness of the preserved greenery in the surrounding areas will make the town aesthetically pleasing. As a matter of fact, according to the community opinion survey, the majority of Gwachon residents share a favourable view of the town in terms of visual attractiveness of urbanscape. (see the section of demography and community identity).

The high-rise apartments, i.e. 14 & 15 storeys, are under construction in order to achieve the balanced development since the majority of apartments being developed are small and medium in size. In between, there are 5-storey apartments and they appear to be an eyesore. They are visually too outstanding and destroy natural and man-made skyline cohesion with the adjacent apartmentscape and valleyscape. The adverse impact will not be reduced to an insignificant level.

c. Mitigation Measures :

(1) Measures incorporated into the design of the project by the developer :

- 35 percent of the new town site (excluding park lands) should be treated with lawn and landscaped with 0.3 trees/m^2 and 0.5 shrubs/m^2.

(2) Other measures that could be incorporated :

- It is proposed to mass plants along the central main road and by-pass road to provide a large scale "natural barrier" in order to negate the adverse physical, visual, and aesthetic impacts: the loss of privacy; the increase in noise; the projected increase in the level of night illumination; and the dust inherent in the construction operations. For this, extra cost would be valued at Won 100,000,000.
- Tree planters could be strategically spaced in the parking lots and shopping malls to reduce the visual monotony of large areas of asphalt and rows of parked cars in the CBD. The installation of 18 planters will cost Won 2,700,000.
- Large-scale trees could be planted to articulate one structure with other structures and open space.
- Maintenance of the project site will be provided by the local government body and residents to preserve the project's aesthetic pleasantness and to maintain the level of attractiveness of the Garden City concept.

7. Regional Development

a. Environmental Setting :

The proposed new town site lies in the region comprising the triangle linking Seoul and Anyang. Other characteristics have been described elsewhere in this study.

b. Impact Assessment :

Because the town is not yet mature enough to make any valid evaluation of its impact on regional development, the comments made in this section will be only interim assessments.

To measure the success of Gwachon new town in contributing to the economic and social stability of the Seoul Metropolitan region, two questions are relevant. Has the new town been successful in attracting people from Seoul ? Has the town stimulated regional employment ?

The original intent of the Gwachon new town was to absorb overspill population from Seoul and to create the hinterland of the 2nd Government Hall. Except for direct employment for 5,000 people provided by the 2nd Government Hall, there is no major source of direct employment in the area since there is no industrial policy. Gwachon, thus, has not made much contribution to alleviate the region's employment problems; if anything, it has provided construction-related jobs. About 3 million people were already attracted to the Gwachon area as a result of construction-related work for phases I, II & III. It is estimated that 6 million people will be employed during the 5 year construction phase of the project. The impact of transporting them to and from the job will be negligible because most construction work begins and ends at the working day earlier than the peak town traffic hours at approximately 8 A.M. and 6 P.M.

According to the social survey carried out by the author, 78 percent of 381 households, i.e. 298 households, moved to the Gwachon new town from Seoul (Table 58).

Table 58. Area of Origin

	No. (Household)	%
Seoul	298	78
Gyonggi Province	26	7
Older Gwachon	13	3
Other Area	14	4
No Reply	30	8
	381	100

Therefore, it can be said that the high proportion of residents housed in the new town are Seoulites.

No data are available to calculate the job ratio which is an index of self-sufficiency. The survey reveals, however, that a large proportion (95 percent of employed residents included in the sample) is involved in journeys to other areas than the Gwachon new town for employment.

- Number of employed residents ..... 475 people
- Number of employed residents who worked elsewhere ..... 450 people
- Journeys to other areas as percentage of employed residents 95%

In addition, a large section of the resident population traveled out for shopping and schooling. A relatively large proportion is also involved in journeys to Seoul.

- Number of residents who have shopping experience at the shopping centre ..... 646 people
- Number of residents who traveled out to other areas for shopping ..... 138 people
- Journeys to other areas as a percentage of all people who used the shopping centre 21%
- Number of Students ..... 189 students

- Number of students who traveled out to go to school
  ..... 92 students
- Journeys to other areas as a percentage of all students
  ..... 49%

Thus, a large amount of daily commuting occurs to and from the town due to the unbalance between employment and other activities and population, and aggravates regional traffic problems. Most of daily commuting for shopping and schooling may have short-term and transitory impacts since these problems are related to the incompletion of the new town.

Although the new town's building volume, i.e. 14,200 dwelling units, is moderate relative to the total volume of buildings in the Seoul metropolitan region in recent years, the role of the new town in the absorption of overspill population is significant. In this area official concern regarding social balance has focused on the question of mixing apartment sizes to provide the class variety within the town.

Table 59 shows neighbourhood characteristics by household income based on the social survey.

Table 59. Neighbourhood Characteristics by Household Income

Site / Household Income	Site I		Site II		Site III		Site VI,VII,VIII & IX	
	No.	%	No.	%	No.	%	No.	%
Less than 100,000			1	1	3	2		
100,001-200,000	1	2	1	1	8	5	1	2
200,001-300,000	11	17	19	19	32	19	8	17
300,001-400,000	11	17	24	25	45	26	9	19
400,001-500,000	4	6	21	21	41	24	14	29
500,000 & Over	31	49	22	22	31	18	14	29
No Reply	6	9	11	11	10	6	2	4
Total	64	100	99	100	170	100	48	100

The neighbourhood characteristics by household income appear to be closely related to the dwelling sizes and heating systems. The siting of large-size apartments (37 and 45 pyong[1/]) would serve to increase even further class differences which already exist among neighbourhoods and the degree of social segregation in the town as a whole. The original aim of the Korea National Housing Corporation was not only the representation of different classes in the town, but the mingling of persons of those different classes.

c. Mitigation Measures :

It is too early to suggest any concrete mitigation measures since the town still has an ambiguous status and regional impacts may be induced (secondary and tertiary) ones.

Chapter V.

SUMMARIZATION OF TOTAL ENVIRONMENTAL IMPACT

A. Application of Traditional Impact Assessment Methodologies

Impact Matrix Land Use Activities

An impact-scaling approach has been used for the display of land use impacts. Table 60 presents the values that have been assigned to the possible effects of the project on land uses. Although this sort of impact-scaling approach is certainly less desirable than a detailed, quantitative evaluation of each land use impact, it at least has the merit of providing decision makers with the best available evaluation of anticipated impacts.

1/ 1 pyong -≒3.3 m^2

Table 60. Impact Matrix Land Use Activities

Project Features	Activities Affected by Proposed Project								
	Residential	Commercial, Business			Open Space/Recreational				Others
	Building Site (Rural Villages)	Retail Sales	Real Estate	Services	Farm	Paddy	Forest	Streams	Road
Creation for new houses for 63,000 persons	9/9	9/9	9/9	9/9	9/9	9/9	4/1	4/2	2/1
Creation of the 2nd Government Hall	9/8	2/2	1/1	1/1	9/9	9/9	4/1	5/6	2/1
Construction of Improved infrastructure including access roads to be dedicated to town.	-	-	-	-	4/9	4/9	8/7	7/4	1/1
Creation of shopping centres for manufacturing and processing supplies	-	-	-	-	4/9	4/9	-	-	-
Generation of air pollution, water pollution, noise,	-	-	-	-	-	-	6/8	6/8	-
Increase in traffic on several roads	-	-	-	-	-	-	-	-	5/9
Provision of public facilities including education facilities	-	-	-	-	4/9	4/9	-	-	-
Provision of parks including playlots, vest-pocket parks, neighbourhood parks and town parks	-	-	-	-	-	-	6/2	3/2	1/1

Note Least Greatest

1. Scale : 1 ← Importance of Impact → 9 / 1 ← Magnitude of Impact → 9

2. " - "sign indicates no interactions.

Checklist Approach to the New Town Project

A matrix is used to relate direct actions on the environment to environmental variables. Figure 21 shows effects on the environment. Impacts of proposed actions on the socioeconomic environment are not included in this matrix.

LEGEND

● : High
■ : Slightly
▲ : Insignificant

ENVIRONMENTAL VARIABLES	DIRECT ACTIONS	Land acquisition, compensation	Initial site clearing	Excavation, cutting	Earth moving, filling	Surface or paving	Roadways, parking areas and green roads	Building (residential)	Building (commercial)	Building (business)	Other miscellaneous buildings	Tunnels and underground structures	Stream channel improvement	Landscape planting	Barriers including fencing	Waste water
Topography	Existing terrain of the site			●	●											
Hydrology	Water level												●			
	Stream blockage (damming)												●			
	Suspended sediment			■	■								■			
	Run off rate			●		●		●	■	■	■			●		
	Pollutant content (residue)			■												●
	Ground water flow level											●				
Vegetation	Type of plants													●		
	Amount of vegetation		▲											●		
	Plant community succession		■											■		
	Food		■													
Climate	Temperature					■		■	■	■				■		
	Wind speed							■	■	■						
	Wind direction							■	■	■						
Visual	Form		●	●	●	■		●	●	●	●			●	■	
	Texture		●			●		●	●	●	●			●		
	Colour		●			●	■	●	●	●	●			●	■	
Existing Villages, families, and business	No. of businesses displaced	●	●													
	No. of employees displaced	●	●													
	No. of dwelling units displaced	●	●													
	No. of people displaced	●	●													
	Cohesion (community)		●													
	Family-graves displaced	●	●													

Figure 21. Effects on the Environment

B. Application of UNEP Test-model : The Extended Cost Benefit Balance Sheet.

One of the features of this version of CBA procedure is to integrate the EIA methodologies with economic project appraisal.

The major feasible mitigation measures which have been incorporated into the project plans and other measures which could be incorporated are integrated according to environmental topics in an Extended Cost Benefit Balance Sheet.

Economic Cost Benefit Analysis (A)

Table 61. Cost Benefit Analysis for the New Town Project Implemented by the Korea National Housing Corporation.(1)

Unit : Won 0 0 0

Capital Cost				Sales Value				Net Balance	B/C Ratio
Item		Quantum	Value	Item		Quantum	Value		
Land acquisition, compensation		511,068 pyong	46,868,443	Apartments		11,710 units	201,728,600	+ 12,518,817	1.05
Urban Infrastructure	Roads	4,340 m	1,806,000						
	Stream improvements	1,770 m	331,000						
	Bridges	2	735,000	Tenement houses		441 units	11,586,300		
	Water purification plant	1	1,191,000						
	Electricity (main line)		2,356,000						
	Dislocation of obstacles		875,000	Shops		7,393 pyong	22,594,100		
	Overbridge, underpass		2,344,000						
	Urban parks		442,000						
	Sub-total		10,080,000	Solar - heated houses		18 units	570,432		
Housing Construction	Apartment	11,710 units	148,696,500						
	Tenement house	444 units	8,065,470	Building Site Sales	Individual plots	678 lots	6,552,399		
	Solar-heated houses	18 units	401,240						
	Sub-total		157,163,210		Schools	32,259 pyong	7,059,385		
Construction of shopping centre		7,393 pyong	5,208,454						
Maintenance buildings		3,771 pyong	2,700,633		Central commercial district	30,330 pyong	7,260,689		
Creation of building sites ofor sales	Individual plots	678 lots	1,685,000						
	Schools	32,259 pyong	1,575,334		Welfare facilities	2,639 pyong	1,122,187		
	Central commercial district	30,330 pyong	1,307,338						
	Welfare facilities	2,639 pyong	126,791		Religious buildings	722 pyong	201,969		
	Religious buildings	727 pyong	32,452						
	Reserved areas	998 pyong	55,888		Reserved areas				
	Sub-total		4,783,803						
Supervision			5,418,598						
Interest during construction			11,851,517						
Taxes and charges			317,662						
Others			1,784,924						
Total			246,177,244	Total			258,696,061		

Table 62. Cost Benefit Analysis for the 2nd Government Hall Project Implemented by the Ministry of General Affairs (2)

Unit : Won million

Capital Cost				Benefit					Net Balance	B/C Ratio
Item		Quantum	Value	Item	Quantum	Value (P)	Present Value ($\frac{P}{R}$)	Calculation		
Land acquisition, compensation			1,500	The 1st Building	8,821 pyong	1,379.1	17,238.75	The present value in perpetuity is derived by dividing rent (P) by the rate of discount "R"(8%)	+262.5	1.005
Urban Infrasturcture	Grading	242,300 m^3	121							
	Paving	290 a	463							
	Sewage & drainage	3,747 m	72							
	Water supply	2,200 m	77							
	Underpass		174							
	Sub-total		907							
Building Construction	The 1st Building	8,821 pyong	5,634							
	The 2nd Building	6,457 pyong	4,569	The 2nd Building	6,457 pyong	1,009.5	12,618.75			
	The 3rd Building	6,500 pyong	9,230							
	The 4th Building	6,500 pyong	9,230							
	Welfare Building	3,789 pyong	4,176							
	Maintenance Building	1,660 pyong	2,773							
	Sub-total	36,150 pyong	39,587							
Public Utilities	Electricity		990	The 3rd Building	6,500 pyong	1,016.2	12,702.5			
	Telecommunication		460							
	Sub-total		1,450							
Other facilities	Green house	1	56							
	Fountain	1	152							
	Sub-total		208							
Landscaping			107	The 4th Building	6,500 pyong	1,016.2	12,702.5			
Taxes and charges			10,401							
Others			840							
Total			55,000	Total		4,421	55,262.5			

Table 63. Cost Benefit Analysis for Direct Services Development Implemented by Other Agencies Concerned (3).

Unit : Won 000

Capital Cost		Benefit		Net	B/C
Item	Value	Item	Value	Balance	Ratio
By-pass Road (50m) Construction	19,158,164	No direct benefit would occur.			
Central Mainroad Enlargement(30m)	5,700,149				
Schools	1,854,083				
Police Station	1,001,112				
Telecommunication & Post Office	3,357,380				
Fire Station	92,238				
City Gas Connection	1,034,000				
Total	31,163,126				

Table 64. Summation of Economic Cost-Benefit Analysis(1 + 2 + 3)

Unit : Won 000

Capital Cost		Benefit		Net	B/C
Item	Value	Item	Value	Balance	Ratio
The New Town Development	246,177,244	The New Town Development	258,696,061	+12,518,817	1.05
The 2nd Government Hall Construction	55,000,000	The 2nd Government Hall Construction	55,262,280	+262,280	1.005
Direct Services Development	31,163,126	Direct Services Development	-	-31,163,126	
Total	332,340,370	Total	313,958,341	-18,382,029	0.945

Environmental Cost Benefit Analysis(B)

Environmental cost benefit analysis is used to fully internalize environmental costs and benefits associated with the new town project in an enlarged cost benefit balance sheet. Table 65 presents measurable and non-measurable environmental costs and benefits of the project.

Table 65. Environmental Cost

Cost						
Resources Indirectly Affected			Residues Created		Resources Restoration Input	
Factors	Description	Quantity	Description	Quantity	Nature	Value
Topography	Loss of fertile top-soil by cut & fill operations.	504,000 m^3			Collection and reuse of fertile topsoil.	☆☆ 174,444
Hydrology	Potential seeps due to the installation of underground utilities collector.		Increase in surface run off		Installation of approved perforated pipe and gravel drains (4,964 m).	☆ 36,993
	Graded and developed slopes by the proposed cut and fill operation.		Sediment production occurred from construction.		Construction of four dams to prevent sedimentation.	☆ 14,500
Climate and Meteorology	Change in microclimate					
Vegetation, Animal and Habitat	Displacement of tress found on the orchard and nurseries.				o Remaining of over 38,897 m^2 as open space. o Landscaping with fruit trees and berry bushes to supply food for residents and to attract shrub and tree dwelling bird species to residential areas.	
Land Use and Zoning	Loss of productive agricultural land.	1,353,900 m^2	Fall in productivity of the surrounding land by continued urbanization due to urban area effluents and disturbance.		o Reclamation of new agricultural lands equalling the lost land areas. o Controlled growth of surrounding areas.	☆☆ 111,000
Dislocation of People and Villages	Displacement of existing people and their property and business leases	o 824 dwelling units o 6,840 people o 359 business leases to be	o Disruption of community cohesion o Creation of community sentiment		o Payment of compensation o Provision of economic base for the displaced people such as store sales with special price	☆ 55,178,770

Note : A summary of the major feasible mitigation measures, which have been incorporated in the project plans and which are considered necessary in this study is presented according to environmental topics.

Benefit Analysis (Measurable & Non-Measurable)

Unit : Won 000

Benefit			
Indirect Output without extra cost to the original project		Resource Restoration Outputs with extra cost to the original project to mitigate adverse impacts under a modified project	
Nature	Value	Nature	Value
		o To increase the growth rate of newly planted trees and shrubs(Reduction in landscape maintenance cost) o To reduce the cost associated with any active seeps o To maintain streams in constant flow(Reduction in stream maintenance cost)	
		o To benefit shrub and tree dwelling bird species. o To landscape completely restructured areas.	
o 542,000 m^2 dedicated by the developer to the town for the planned park & open space system. o Increase in surrounding property values.		o To prevent a reduction in the amount of agricultural lands important to the national economy. o To preserve surrounding open space in the face of urban development pressures.	
o The developer sold lots for single detached houses to displaced people at cheaper price(Won 134,000/pyong in the case of the first stage development area, 127,000 in the case of the 2nd stage) than current market price (Won 500,000/pyong). Therefore, the differences between special sales price and current market price would be Won 366,000.		o To ease uncertainty o To reduce probable indirect social problems such as unemployment.	

☆ Sign indicates the mitigation measures which have been incorporated in the project plans and already considered in the Economic Cost Benefit Analysis.

☆☆ Sign indicates the mitigation measures which are considered necessary and need extra cost for them and included in the enlarged cost benefit analysis (measurable).

Cost						
Resources Indirectly Affected			Residues Created		Resources Restoration Input	
Factors	Description	Quantity	Description	Quantity	Nature	Value
		affected			and supply of agricultural lands.	
Trans-portation	Increased traffic volumes		o Local and regional traffic congestion resulting in wasting of time and energy o Excess air pollutants and noise		o Widening work of the central main road(from 30 m to 50 m). o Construction of the by-pass road (50 m). o Widening of the existing road between Dongjak-Dong National Cemetery and Sadang-Dong Rotary (3.2km, 30-50 m). o The planned bicycle road (2,650 m). o Extension of bicycle road (990 m). o Traffic signal controls be installed on site.	☆ 5,700,149 ☆ 19,158,164 ☆ 12,778 ☆☆ 4,774
Air Quality	o Vegetation (Conifers)		o Air pollutants including sulphur dioxide (SO_2), carbon monoxide(CO),nitrogen oxides (NO_x),hydrocarbons(HC),oxidants and suspended particulates(SP)		o Increase of stack heights of heating plants from 30m to 60m o Planting of vegetation along major roads o Improvement of traffic flow.	☆ 240,000
Noise	o Public health		o Noise pollution		o Landscaping of bufferzone (trees closely spaced to provide	☆☆ 100,000

Benefit			
Indirect Output without extra cost to the original project		Resource Restoration Outputs with extra cost to the original project to mitigate adverse impacts under a modified project	
Nature	Value	Nature	Value
Won 21,110,880,000 is derived by multiplying Won 366,000 by 57,680 pyong (70 pyong x 824 house holds). Here 70 pyong means individual lot size and 824 households are the number of households benefited from special sales.		o To save time and energy o To reduce air pollutants and noise pollution o To increase site accessibility o To elongate human life time o To protect vegetation particularly sensitive to projected air pollution. o To reduce conflict with residential land use o To elongate human life time	

Cost						
Resources Indirectly Affected			Residues Created		Resources Restoration Input	
Factors	Description	Quantity	Description	Quantity	Nature	Value
					a natural barrier) in central main road and by-pass road to mitigate noise impact from the roads o Construction of noise protection wall o Construction of noise protection mount	110,000
Demography & Community identity	o Increased population o Change in demographic composition o Change in desires o Community sentiment caused by the loss of family graves		o Average population density of apartment complexes I, II & III (550 people /ha) exceeds target population density (274 people/ha o Increased demand for health, welfare (community centres, etc.), education services, shopping centres, fire, police, postal, energy & utilities, park and recreation areas, and other public services. o Urbanization pressure on the site-adjacent agricultural lands. o Impacts on rural life style of the surrounding areas.		o Compensation made in order to relieve the community sentiment caused by the loss of family graves. o An extensive, long term association between the 2nd Government Hall and Town to plan government-community relations together for their mutual benefit and "community spirit". o Supply of more enlarging households.	11,415
Energy Conservation	o Creation of a new source of demand for irrecoverable resources.		o Air pollutants (CO, NMHC, NO_2, SP, SO_2)		o Construction of solar-heated houses(40-50% energy reduction)	

Benefit			
Indirect Output without extra cost to the original project		Resource Restoration Outputs with extra cost to the original project to mitigate adverse impacts under a modified project	
Nature	Value	Nature	Value
		o To develop a joint-use facility for the benefit of the Gwachon new town and the 2nd Government Hall o To create "community spirit" o To minimize effects of increased crowdness.	
o Technology transfer : o The solar-energy houses will incorporate the latest technology (40-50% energy reduction). The technology is relatively new to Korea.		o To save energy o To reduce air pollution emissions o To reduce collection cost of disposal waste	

Cost						
Resources Indirectly Affected			Residues Created		Resources Restoration Input	
Factors	Description	Quantity	Description	Quantity	Nature	Value
	(Water, gas, electricity etc.)		o Heat discharges o Disposal waste		o Incorporation of adequate insulation into the building design o Air conditioning and heating equipment should be designed, so as to minimize the use of energy o Lower car uses	
Sanitary Sewers	Water		o Generation of waste-water o Periodic releases of noxious gases o Decrease in surrounding property values	33,125,000 litrepcd per day	o Construction of a planned waste-water treatment plant. o Expansion of 30,000 ton/day to 34,000 ton/day of design capacity.	☆ 8,600,000 ☆☆ 800,000
Solid waste	Land		o Generation of solid waste o Increase in traffic on local streets	126,000 kg/day at full occupancy	o Installation of a sanitary landfill(30,000 m^2)	☆☆ 2,400,000
Water/ Power/ Communication	o Water o Electricity		o Consumption of water o Consumption of electricity	27,940 ton/day 77,750 kw	o Construction of a water purification plant (30,000 ton of water per day) o Telephone service may have to be re-examined to provide inner-city system	☆ 1,191,000
Recreation and Parks	o Land o Vegetation		o Increased demand for recreation and parks.	597,060 m^2	o Originally proposed park space(588,460m^2) o Creation of additional 8,600 m^2 park space to meet neighbourhood park standard	☆ 1,248,151 ☆☆ 18,241

Benefit			
Indirect Output without extra cost to the original project		Resource Restoration Outputs with extra cost to the original project to mitigate adverse impacts under a modified project	
Nature	Value	Nature	Value
o Demonstration of a model of leading city performing self-sustainable roles through rational allocation of urban function.			
		o To reduce water pollution to an acceptable level (conservation of the Han-River) o To increase neighbourhood livability	
		o To serve the proposed development adequately o To increase project livability	
		o The public utilities projects would enable the town to move ahead with possible plans to allow future development of the residential and commercial areas known as "Seoul City Planning Area".	
To create park space (588,460m^2)		o To create additional park lands (8,600m^2) o To provide a sense of relief from the structural harshness and coldness associated with intensive urban development o To increase enjoyability at various kinds of park facilities	

Cost						
Resources Indirectly Affected			Residues Created		Resources Restoration Input	
Factors	Description	Quantity	Description	Quantity	Nature	Value
					recommended by the city general plan preparation guideline. (8,600m^2)	
Visual/ Aesthetic /Atracti-veness	o Rural landscape o Gwanak and Chyongge Natural Park environment.		o Visual pollution		o 35 percent of the new town site(excluding parklands) should be treated with lawn and landscaped with 0.3tree/m^2 of trees and 0.5 shrub/m^2 of shrubs. o Installation of 18 planters in CBD. o Large-scale trees would be planted to articulate one structure with other structures and open space.	☆☆ 2,700
Regional development	o Population o Administrative functions o Economic activities o Transport o Commercial activities		o Cross-movement of regional population o Increased regional traffic volumes o Pollution forming part of Seoul metropolitan airshed -- cumulative degradation of the air quality in the regional airshed. o Social segregation.		o Mixing of the apartment sizes to attract different classes and to achieve the mingling of persons of those different classes.	

Benefit			
Indirect Output without extra cost to the original project		Resource Restoration Outputs with extra cost to the original project to mitigate adverse impacts under a modified project	
Nature	Value	Nature	Value
o To reduce detraction from the aesthetic appeal of its natural surroundings		o To reduce detraction from the aesthetic appeal of its natural surroundings o To enhance attrativeness of urbanscape	
o Urban decentralization(Target population : 63,000 people) -Increased decentralized urban base. o Decentralization of administrative functions (Government employees : 5,000 people) o Employment : This assists in alleviating pressure on the region's unemployment situation : Number of new short-term jobs provided (construction-related jobs) : -The new town development : 6 million people -Gwachon water purification plant : 5,000 people Number of new long-term jobs provided(direct employment) : -The 2nd Government Hall : 5,000 people -Gwachon water purification plant-51 people o Provision of new quality(high value) housing(14,200 dwelling units)		o To reduce social segregation resulting in more community vitality	

Benefit			
Indirect Output without extra cost to the original project		Resource Restoration Outputs with extra cost to the original project to mitigate adverse impacts under a modified project	
Nature	Value	Nature	Value
-Creation of a bed town. o Increase in tourism opportunities together with development of the Seoul Grand Park. o Increased revenue to central and local governmental tixing and charging units o Production-inducing impacts -By using building materials at Gwachon, the building industrial base of the region has been/will be significantly broadened. o Growth-inducing impacts -Increase in adjacent land and property values.			

Enlarged Cost Benefit Presentation (A + B (only measurable))

Table 66. Enlarged Cost Benefit Analysis(Measurable)

Unit : Won 000

Item	Costs	Benefits	Net Balance	B/C Ratio
Economic Cost -Benefit	332,340,370	313,958,341	-18,382,029	0.945
Environmental Cost-Benefit (Measurable)	3,961,159	-	-3,961,159	0
Enlarged Cost-Benefit	336,301,529	313,958,341	-22,343,188	0.934

If the fourth stage development is completed and new apartment and other things such as shopping centres are sold, the enlarged B/C ratio will be higher than 0.934 as of mid-stage of construction since most direct services development have already been completed. In addition, the result may be more positive if an attempt is made to valuate non-measurable secondary and tertiary benefits so far as possible.

Chapter Ⅳ.

ALTERNATIVES TO THE PROPOSED DEVELOPMENT

A. Alternatives

1. "No project" Alternative

Most of the proposed sites were agricultural lands whose values have already shot up the limit at which farming is not economical. About 824 single-family dwelling units were already occupied.

The through traffic from Seoul to Anyang gradually increased. The site constitutes part of the Seoul metropolitan airshed.

Therefore, "No Project" alternative would still result in substantial urbanization of the site.

Without the project, the adverse impacts associated with the project would be voided and the site would remain in a more natural state.

2. Change in Intensity

Population density problems occur at present. Controlled growth on the surrounding area may be more desirable than modification of the project plan itself. Thus, no density alternatives are presented for comparison.

3. Change to a Different Type of Land Use

The central government designated the site for the 2nd Government Hall and its hinterland which will contain high value houses and apartments, therefore, no other land use would be considered viable.

If the development would not have been implemented, the conservation of agricultural land would have been made possible.

4. Alternative Sites

Urban developments may not spread to adjacent farmland due to the present greenbelt policies. Other nearby sites present terrain and access problems. The objective of the developer is to secure a reasonable use for this specific site. Within this context, it would appear that there is no useful purpose to explore alternative sites.

Although mitigation measures add to project costs, these conditions do not justify the selection of alternative development sites since the high cost of land makes these measures economically feasible.

B. Project Justification

The proposed project represents continuing implementation of an adopted decentralization plan for Seoul city. The project beneficially allows the dedication of approximately 542,000 m^2 of permanent open space to the town for park purposes. The project will provide 14,200 units of high value houses. It will create new short-and long-term jobs and production-inducing impacts.

Although the final analysis of an enlarged cost-benefit analysis shows negative net revenues, it is likely that the result may be positive if an attempt is made to valuate non-measurable benefits that might accompany the proposed new town development after the completion of the development. In addition, the fourth stage development in the area will make it more beneficial to develop the town.

Actions which can be taken to minimize some of the adverse effects of the project should include a strictly controlled growth of the surrounding area.

Obviously, a further increase of the projected population density would possibly be counter-productive to the original garden city concept. A monitoring programme is recommended.

Chapter Ⅶ.

EVALUATION OF EFFECTIVENESS OF METHODOLOGIES EMPLOYED

The developed extended cost benefit analysis model for the new town project has been applied to a case study of the Gwachon new town.

As a result of the study, it can be said that traditional environmental impact assessments should be considered as a prerequisite for the effective application of CBA. In this sense, the extended CBA is regarded as a methodology to quantify the total environmental impact. On the other hand, matrix methods were useful tools for relating the proposed land use types to the actions on the environment allowing to deduce categories of operationally useful environmental alterations from land use types (as was explained in chapter II). Summarizing the total environmental impact, a merit of extended cost-benefit analysis is the evaluation of mitigation measures whose costs are added to project costs where possible, with qualitative descriptions prepared for the balance.

This study has had the fortune to have Gwachon new town as a case study area since it provides a good source of information and enabled us to carry out two different social surveys. The social surveys provide a way for public input in the interpretation of impact significance. In addition, it proves that any fairly sophisticated analysis involving scientific judgement and expertise of various kinds is likely to lead to conclusions that could be usually in favour of the project. Conversely, in the case of population density, it is evident that the housing density which is observed at sites I, II and III is above the professionally acceptable standards of density. However, according to a social survey carried out by the author, the majority of respondents have not felt the population density be a major problem so far. This sort of survey provides base-line information against which social assumptions of the planners can be re-examined.

The generation of indirect costs and benefits stemming from the public project were considered in this study. Most indirect costs in monetary terms are derived by implementing steps which can be taken to mitigate adverse impacts while these measures add to project costs in the enlarged cost-benefit analysis. In the Gwachon new town, the high

cost of land and structures makes these measures economically feasible.

This implies that these conditions may not justify the selection of alternative development sites although Gwachon is in a rural locality.

In terms of time, the applied method limited operational-phase impacts since many impacts are closely related to people-oriented services. This study may be incomplete in the sense that we did not fully consider a distribution of cost-generating and revenue-producing sources in the town. For example, all education costs (a "service of community-wide benefit") can be allocated to residential lands. In Gwachon, among people-oriented services, are a new sewerage plant whose costs have been allocated to house sales prices and a transportation network whose costs have been paid by the Ministry of Construction.

In this study, we tried to treat all direct costs and benefits caused by the development in monetary terms, and attempted to identify and quantify the indirect costs and benefits that could be anticipated from the proposed development where possible. To the extent that secondary, tertiary and tetrary impacts are identified and quantified as long-term impacts, the methodology employed can be a valuable aid to environmental policy decision makers. For this purpose, the impact tree can be regarded as a complementary method to trace the incidence of these effects so far as possible.

It should be emphasized that the sources of data are absolutely essential in any of the extended cost-benefit analyses since it is difficult to calculate costs and benefits without detailed plans and schedules furnished by the developer for development of the area. Performance budgeting requires monitoring and data collection for all the relevant departments and agencies, but it may yield significantly different results from the other methods such as the Project Engineer's estimate. In reality, we found that, even in a performance budgeting, the records of different departments and organizations utilize widely varying methods of accounting.

Periodic reassessment of objectives and accomplishments will enable the Town to continue to serve the best interests of the population.

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APPENDICES

I. ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR NEW TOWN DEVELOPMENTS.

II. SURVEY RESULTS

A. Social Survey of a Village to be Displaced.

B. Social Survey of the New Town

I. ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR NEW TOWN DEVELOPMENTS

CONTENTS

I. INTRODUCTION

This guide provides the framework for preparing environmental impact statements (EIS's) on new town development plans and serves as a reference to those who prepare such EIS's. It is intended to provide certain minimum standards of completeness and consistency in those EIS's to be prepared under the Environmental Preservation Law of 1978.

The Guide provides the approach to environmental impact assessments by defining the substantive issues, setting forth the critical assessment questions, and recommending mitigation measures. Use of the Guide will provide essential documentation needed to aid OOE decision-makers and provide substantive evidence of proper OOE reviews.

It must be kept in mind that the importance of individual environmental factors may vary substantially with the type of a new town development and its location. The details of the analysis methods are uneven due to the state-of-the-art of review techniques, which are much better developed for some environmental factors than for others.

The Guide does not recommend techniques for forecasting the environmental effects of proposed actions. The preparers should use any forecasting technique(s) considered appropriate. Notwithstanding the need for uniformity in the preparation of EIS's, the organization and content of the EIS that is specified in the Guide, may be altered. One must recognize that each new town development plan is an individual case. EIS's should be geared to the specific complexity of the environmental problems associated with the new town development plan under review.

It should be updated when necessary to incorporate changes and additional information as developed. To improve the usefulness of this Guide, constructive comments and suggestions reflecting actual experience are very welcome. Such comments should be furnished to Prof. Kwi-Gon Kim, Seoul National University, Seoul 151, Korea.

II. SUMMARY

Based on the data and analyses conducted, a brief summary should be provided. Specific details should not be given here. In this regard, the summary should be as brief as practicable.

To this end, if a proposed action has an obvious overriding environmental problem, the preparer should make this clear in the summary and concentrate on that problem and the results of its analysis while providing summaries of the other analyses carried out according to this Guide.

III. PROJECT DESCRIPTION

A. Background of the Project

If a development application has been made, briefly describe the origin of the application, its priority determination and government approval.

The general and specific location of the proposed actions should be provided. To minimize the narrative, a clearly defined map of the planning area or the general area in which the proposed action will take place should be provided (if available). The narrative should briefly describe the location of the development project, referencing urban systems, transportation systems, regional park and open space systems and river systems.

B. Overview of the Project

A description of both structural and non-structural actions should be provided. The objectives and goals of the project should be provided. Enumerate the total anticipated project costs if the proposed actions are recommended and approved.

The interrelations of proposed land use types and actions on the environment should be provided to indicate actions on the environment associated with land use types of new town development programs and locations.

IV. GENERAL DESCRIPTION OF ENVIRONMENTAL SETTING

A. Overview of the Environmental Setting

The social, economic and environmental setting of the area of the proposed action is important for the decision maker and the public. The environmental setting is the starting point from which forecasts of the environmental impact of the proposed action must be made. However, specific details should not be given here.

These should be covered in Chapter V, "Environmental Impact Analysis," to describe base-line data against which prediction and assessment of the impacts of the proposed action can be compared.

While the focus should be on the immediate area of the proposed actions, where appropriate, parts of the surrounding area should also be included to avoid the risk of overlooking any important regional impacts.

The importance of using maps and aerial plotos to illustrate topics is stressed ---- especially where environmentally sensitive areas are concerned. The narrative should be concise, not exhaustive.

Only those characteristics of the socioeconomic and environmental setting which are most important in relationship to the proposed development should be discussed in any detail, and those which are not particularly relevant should be omitted.

B. Inclusion and Exlusion of Specific Factors for Consideration in Assessing the Impacts.

The detailed environmental description should include the items

discussed in the following chapter when they are relevant to the determination of environmental impacts after implementing the proposed action or analysis of alternatives. Note that in many instances some of these items will not be relevant to the decisions to be made, or their significance can be appropriately covered by a very brief description.

The relative merits of different arguments advanced by different interests should be weighed up through formal and/or informal personal interviewing about how people judge the seriousness of likely effects.

V. ENVIRONMENTAL IMPACT ANALYSIS

Here environmental setting of each factor selected in B of Chapter IV should be described. Prediction and assessment of the impact of the project on the natural/physical factors and socioeconomic factors are required.

The methods required for the future-year impact analysis will be more comprehensive than those required for the existing environmental quality analysis. This chapter should also include recommendations on how to reduce or remove the most serious of the impacts as measured and as socially valued. The costs of mitigation measures should be quantified where possible, with qualitative description prepared for the balance. A programme of inspection both during project construction and after project completion to ensure that environmental effects are minimized should be made.

A. Natural/Physical Factors

1. Physical Site Suitability

a. Environmental Setting

Soil characteristics and surface and bedrock geological conditions that will have a direct influence on site suitability for development of buildings, sewers and underground utility trenches.

b. Assessment Questions

The following questions should be asked :

(1) Is there any visible evidence of soil and foundation support problems, basements flooding, etc, -- in the neighbourhood of the project site ?

(2) Have soil and geological studies or borings been made for the area ? Do they show unsatisfactory soil and geological conditions ?

(3) Is there evidence of high side seepage potential when underground utility collectors are to be installed ?

(4) Are there any signs of cracks in building walls, sagging roofs or other indications of foundation failure in the vicinity ?

c. Mitigation Measures

Steps which can be taken to mitigate soil suitability and foundation support problems include :

(1) Installation of drainage facilities in low areas to make the soil stable for construction

(2) Altering foundation design, by using pilings, or increasing the bearing areas of spread footings

(3) Replacement of problem soil with more satisfactory fill

(4) Installation of approved perforated pipe and gravel subdrains to prevent seepage potential

(5) Possible alternative site landuse configurations

2. Topography

a. Environmental Setting

Describe the topography of the area of the proposed project delineating the major and minor drainage basins along with their characteristics -- slope, elevation, natural and artificial drainage nets, erosion, and deposition.

b. Assessment Questions

The following questions are pertinent :

(1) Would the proposed project result in substantial modification of the terrain ?

(2) Does the project involve development of an erosion sensitive area ? If so, is erosion control included as part of the new town development plan ?

(3) Does the project involve the change in the orology which influences existing localized wind flow patterns and other weather features ?

(4) Does the proposed project create slopes by cut and fill ? If so, is landscape revegetation of these slopes included as part of the plan ?

(5) Does site clearance require vegetation removal ? How many acres will be cleared and for how long? Is landscape restoration of the cleared areas included as part of the plan ?

(6) Is there any visible evidence of sedimentation problems on the site ?

c. Mitigation Measures

Erosion is often most critical during land development and construction, before earthwork is completed and mitigation measures are in place. Temporary mitigation measures may be necessary during this stage. The following measures are usually used in combination :

(1) Phase grading to expose only those areas necessary at each phase in order to limit extent and exposure time of distributed soils

(2) Divert surface runoff from erodible soils

(3) Create berms on steep slops to break up slope lengths and slope runoff, and terrace downhill slopes

(4) Collect and reuse all top soil beneath proposed cut and fill areas

(5) Plant all fill and cut slopes

3. Hydrology

a. Environmental Setting

Describe the relevant surface water bodies and ground water aquifers in the area. Describe the existing surface and ground water quality using physical, chemical and biological parameters. Describe the existing surface and groundwater quantity and relate to water uses. Include a discussion of surface water volume, stream flow rates and the frequency and duration of seasonal variations. If regulating (dams ; locks) or diversion (dams ; tunnels ; canals) structures are in place, or proposed, these should be identified. Address specifically the relevant point and non-point sources of pollution such as those arising from industry, municipalities, combined sewers, storm water run-off, agriculture, silviculture, aquaculture, mines or mine drainage, and salt water intrusion. Regulatory and administrative procedures in force to reduce water consumption (thereby reducing waste volume) should be noted if significant. Describe all pertinent areawide or basin water quality and quantity management plans.

b. Assessment Questions

To reduce the length of this section, only selected assessment questions will be explored :

(1) If the project is to use groundwater from the site, is there evidence that supplies are adequate and free from pollution ?

(2) Will the project involve discharge of sewage effluent into

surface water bodies ? If so, will the effluent meet national and other applicable standards (i.e. WHO standards) ?

(3) Will the project involve a substantial increase in impervious surface area, and, if so, have runoff control measures been included in the design ?

(4) Will the project divert or change a stream or lake ?

c. Mitigation Measures

Steps which can be taken to mitigate impacts on surface water and groundwater include :

(1) Expansion of public wastewater treatment facilities to remedy the overloading of those facilities.

(2) Improvement of town storm drain system and water channel.

(3) Inducement of runoff control measures in site design -- such as on-site storage or routing to settling basins prior to discharge into surface waters.

(4) Prohibition of surface water to accumulate in excavations or depressions about the site.

(5) Limitation of the amount of pumping to safe annual yields in areas where pumping poses a problem.

(6) Design of underground spaces to withstand pressure of groundwater and provision to pump out seepage in locations with high water problems.

(7) Special design of wastewater disposal systems to function properly in high water table conditions.

4. Climate and Meteorology

a. Environmental Setting

Describe the climatic conditions for the general area of the proposed actions including temperature, precipitation, humidity, and wind direction and velocity. Wind roses indicating the frequencies of the wind direction in conjunction with corresponding wind speeds should be included.

List any specific weather conditions including fog and hurricanes and the frequency at which they may be anticipated. In addition, provide data on mixing heights and the frequency of inversions related to the planning area(s). This data must be based on at least one year observation. Also describe any topographic and structural features which influence the weather.

b. Assessment Questions

1. Does the development area belong to greater airsheds ?
2. Will the development lead to significant changes of microclimatological conditions ?
3. Will the development decrease the visibility ?
4. Will the development decrease the sunlight ?
5. Will the urban heat island phenomenon lead to significant differences in temperatures between the development area and its surroundings ?

c. Mitigation Measures

(1) Restrict the height of buildings
(2) Enlarge open spaces (lay out parks, green belts etc.)

5. Air Quality

a. Environmental Setting

Describe the meteorological setting of the development area in terms of wind roses indicating the frequencies of different wind directions in conjunction with corresponding wind speeds, and the frequency of inversions with corresponding mixing heights. This data should be based on sufficiently long observations. In addition, data on air temperature, humidity, sunshine hours, cloud cover and precipitation should be provided together with the topographical and orographical characteristics of the development area. Based on these data, the potential for air pollution should be assessed.

Carry cut a survey of the existence of sensitive receptors that could possibly be damaged.

Evaluate available air quality data of criteria pollutants including SO_2 and TSP by relating the concentrations to corresponding ambient air quality standards. Pay attention that the measured concentrations are expressed as a function of averaging time and frequency which are compatible to the standards. Determine the capacity for further increase of air pollution levels.

If no suitable data are available, plan and set up an appropriate monitoring programme to assess the air quality prior to the development. Select those pollutants which are considered to be most critical. Achieve your goal by selecting the most economical means without neglecting professional judgement.

Determine the expected emission rates of different source categories based on projected fuel consumption data and applying appropriate emission factors. Collect data on source characteristics. Use a suitable air quality diffusion model (SCAM, CDM, etc.) to determine future air quality levels taking into consideration the compatability of standards with predicted concentrations.

Based on the comparison of standards and predicted concentrations, conclusions have to be drawn with regard to possible mitigation measures.

b. Assessment Questions

(1) Does the development area belong to a local or regional airshed ?
(2) Do the existing air quality levels of different criteria pollutants allow further pollution of the air ?
(3) Will the development lead to significant changes of the existing air quality levels ?
(4) Will the corresponding ambient air quality standards be exceeded ?
(5) Does the area contain sensitive receptors (wildlife,

vegetation, material, national treasures, etc.) ?

(6) Are damages on receptors already established or can they be expected based on the predicted changes in air quality levels ?

(7) How large will be the affected population ?

c. Mitigation Measures

Mitigation measures can include :

(1) Substitution of "dirty" fuels through "cleaner" fuels

(2) Use of "cleaner fuels" during unfavorable meteorological conditions

(3) Increase of stack heights (this measure, however, is only advantageous from a local point of view but has to be carefully assessed from a regional, national or international point of view)

(4) Installation of high efficiency control equipment

(5) Traffic management (improvement of traffic flow, etc.)

(6) Planting of trees and bushes

(7) Paving of roads

6. Noise Pollution

a. Environmental Setting

Describe the existing noise sources (road traffic noise, railway noise, aircraft noise, industrial noise, etc.). Carry out a noise survey including the determination of the type of noise (continuous noise vs impulse noise), noise fluctuations, and duration. If possible, determine the frequency composition of the noise. Compare existing noise levels with environmental quality standards for noise. Based on predicted road traffic volume, traffic composition and traffic speed in the development area, calculate the expected noise levels at different receptors (apartments, schools, hospitals, etc) for closed window conditions. Study land use plans for surrounding areas (construction of express ways, construction of airports, construction of industrial complexes, etc.). Estimate the influence of these activities on the predicted noise levels.

b. Assessment Questions

(1) Do the existing noise levels allow a new development ?
(2) Will the development lead to significant changes of the existing noise levels ?
(3) Will corresponding environmental quality standards for noise be exceeded ?
(4) Does the area contain sensitive receptors (hospitals, schools, nursing homes, recreational areas, etc.) ?
(5) How large will be the affected population ?

c. Mitigation Measures

Mitigation measures can include :

(1) Reduction of noise levels at the source based on different measures including damping, absorption, dissipation, etc.
(2) Construction of barriers between the noise source and personnel, e.g., mounds, walls of sound absorbing material, walls of wood, cement or blocks.
(3) Planting of trees or bushes.
(4) Reduction of noise levels at the receptor (installation of double windows, etc.).
(5) Architectural design of buildings (location of bedrooms opposite to noise sources, etc.).
(6) Traffic management (enforcement of speed limits, restriction of the use of horns, improvement of traffic flow, prohibition of traffic during nighttime at designated roads, prohibition of designated vehicles at certain roads, etc.).
(7) "Bundling" of roads, relocation of roads (also lowering of the road level compared to the surrounding area).
(8) Limitation of flight altitudes of aircrafts and restriction of flight times.

7. Energy and Utility Services

Energy Conservation

a. Assessment Questions

The following are the major questions regarding this factor :

(1) Does the location of the new town site have any special energy related advantages or disadvantages and can these be maximized or overcome ?

(2) Have the plans taken full advantage of potential energy saving measures, such as creation of a self-contained community, lower car use, proper orientation, insulation, window design and placement, lighting, heating, cooling and hot water systems ?

(3) Is the project in conformance with applicable energy saving codes ?

(4) Are utilities already installed, and will they be available for use by the project ?

(5) Does the plan involve any efforts to simplify transportation needs to save energy ?

b. Mitigation Measures

Mitigation measures may involve :

(1) Redesigning existing land use patterns to conserve energy through ecologically sound planning policies.

(2) Avoiding high cost of energy to the project, inefficient energy supply and securing the most efficient energy saving practices.

Sanitary Sewer

a. Assessment Questions

The following questions should be asked :

(1) Will the existing or planned waste water disposal systems provide satisfactory service to the proposed development ?

(2) Will the design capacity of the wastewater treatment plant be exceeded by the project as proposed in terms of the type and density of development ?

(3) Will the effluent (treated water) cause pollution problems when it is discharged ?

(4) Will the proposed project be adversely affected by the proximity of the disposal facilities ?

b. Mitigation Measures

(1) Use of water saving fixtures to reduce the amount of waste water

(2) Expansion of the existing waste water facilities, either individual septic systems or some form of package treatment plant and/or construction of new facilities.

Solid Waste

a. Assessment Questions

(1) Will the existing or planned solid waste disposal system adequately serve the proposed development ?

(2) Will the proposed development overload these facilities (either recycling, incineration, or disposal in a sanitary landfill) ?

(3) Will the town provide collection service either directly or by contract ?

(4) Will the community have an adequate number of vehicles to provide the project with collection service ?

b. Mitigation Measures

Mitigation measures will vary according to the specific problem. They may include :

(1) Expansion of existing landfill sites and/or installation of new landfill sites.

(2) Introcution of better compaction, incineration and recycling methods.

(3) Increase in collection capacity, either by local government, or through their contractor.

Water Supply

a. Assessment Questions

(1) Will either the municipal water utility or on-site water supply system (e.g. individual wells) be adequate to meet the project's demand ?
(2) Will the project receive a sufficient amount of potable water meeting public health standards according to pertinent areawide or basin water supply management plans ?
(3) Will the project affect a sole source or other aquifer ?

b. Mitigation Measures

(1) Encouragement of water conservation through design and construction.
(2) Allocation of a sufficient amount of water for the main reservoir and extension of the existing water purification plant and/or installation of new plant.
(3) Maintenance of infiltration so as not to deplete groundwater supplies for aquifer recharge areas by on-site retention to delay runoff and promotion of infiltration by controlling runoff and site design to minimize impermeable surfaces.

8. Vegetation, Animal and Habitat

a. Environmental Setting

Indicate those species in the area which have been designated rare or endangered, either at the provincial level or nationally. Describe wildlife habitat or portion thereof which might be affected by the project.

b. Assessment Questions

The assessment question on vegetation encompasses :

(1) Will the project damage or destroy existing plant communities listed as rare or endangered species ?

(2) Will it damage or destroy trees without replacement and landscaping ?

(3) Will the project create environmental conditions which might threaten the survival of existing vegetation, particularly changes in the native plant community habitats ?

(4) Will it create conditions favourable to nuisance species ?

(5) Will it provide planting for trees which transfer disease to adjacent agricultural crops ?

The assessment question on animals encompasses :

(1) Will the project create special hazards for animal life ? What types of animals will be affected and how ?

(2) Will the project provide planting for fruit trees and berry bushes to attract shrub and tree dwelling bird species to residential areas ?

(3) Will the project damage or destroy existing wildlife habitats ?

(4) Will the project threaten any animal species listed by either provincial or central agencies as rare or endangered ?

(5) Will the project create conditions favourable to the proliferation of pest species ?

(6) Will excessive grading alter the groundwater level and thus cause the slow death of trees and ground cover which in turn destroys animal habitats ?

c. Mitigation Measures

Mitigation Measures include :

(1) Altering project plans to avoid impact on critical habitat areas

(2) Transplanting a particular species of plant or animal life to a new suitable location

(3) Planting native berry bushes to feed or shelter protected

wildlife species, with plants which are grown under local conditions, if available.

(4) Setting aside the critical habitat area as a park or natural area.

(5) Planting native vegetation in landscaped and open space areas of the project site.

(6) Avoiding the use of species in landscaping that are invasive and likely to establish themselves in adjacent croplands.

(7) Avoiding the use of tree species in landscaping that are likely to transfer disease to adjacent agricultural crops.

9. Unique Natural Features and Areas

a. Environmental Setting

Identify and show on a map unique geological features and mineral resources. Their uniqueness stems from their infrequent occurrence, their aesthetic value, or their information content.

Mineral resources are usually divided into three categories : fossil fuels, metals, and non-metals.

b. Assessment Questions

The impact assessment should be based on the following questions :

(1) Will the project location, construction, or activities affect unique natural features or resource extraction on or near the site ?

(2) Will the project either destroy or isolate from public or scientific access the unique natural features ?

(3) Will the unique feature or resource extraction activity pose safety hazards for a proposed development ?

c. Mitigation Measures

Mitigation Measures may include :

(1) Modify project plans to minimize impacts on the feature

(2) Provide visual and physical access to unique features
(3) Set unique feature aside as park or natural area
(4) Allow scientific excavation of fossil beds or other features before destruction of features is allowed
(5) Fence off areas which may create a site hazard.

B. Socioeconomic Factors

1. Land Use and Zoning

a. Environmental Setting

Describe compatibility with surrounding land uses in terms of harmful effects of industry and commercial operations such as heavy traffic, noise, air pollution and other hazards in residential areas. If available, include a map of existing land uses such as residential, commercial and services, industrial, cluster housing, strip development, extractive (mining, etc.), transportation, communications and utilities, institutional, open space and outdoor recreation, agricultural, forest land, water, archaeological, historical and other points of interest in the area of the new town developments. If available, include a map of land uses, both private and public, for those categories listed above, which are currently being proposed by local, regional or national governments in the areas of the new town developments. Describe the administrative and regulatory land use controls now in effect. Describe the administrative and regulatory land use controls now in effect. Describe development trends for the industrial, agricultural, commercial, residential, and recreational sectors. Describe any aspects of these trends which might threaten air or water quality or bring about other environmental problems.

b. Assessment Questions

(1) What are the existing land uses adjacent to the proposed project and will the proposed project be compatible with the existing development ?

(2) Is the project protected from incompatible uses by proper zoning ?

(3) Will the proposed project substantially alter residential, commercial or industrial land uses ? Will the planned land uses meet national and other applicable standards ?

(4) What are the effects of a proposed development on the intensity of land use ?

(5) What are the probable environmental, economic and social effects of the possible changes in land use ?

(6) Will the proposed project result in induced development which will alter the existing land use pattern in site-adjacent areas ?

c. Mitigation Measures

In most cases the measures available consist only of altering the project itself. However, in some cases there may be other options such as :

(1) Reclamation of new agricultural lands equalling the lost areas to complement the loss of agricultural land at the proposed site.

(2) Controlled growth on surrounding area.

(3) Reduction in population density to meet recommended standards.

(4) Installation of fencing to prevent human intrusions including tresspass onto neighbouring agricultural lands.

(5) Redesign site to separate or screen objectional neighbourhood features.

(6) Use of berms, barriers and screens to reduce impacts of unsightly neighbourhood features.

2. Dislocation of People and Village

a. Environmental Setting

Describe the direct and indirect dislocation (or displacement) of people, businesses, institutions, villages or community facilities as a result of a proposed project. Identify socioeconomic variables which

are most visible in transfers from rural to urban areas.

b. Assessment Questions

The following questions will assist in determining whether there is any potential for dislocation, particularly in metropolitan areas.

(1) Will the project require current occupants of structures to leave from the new town designated area ? If so, how many and when ?

(2) Will the project require the demolition of existing occupied structures ? If so, how many and when ?

(3) Are other housing units or commercial buildings readily available in the immediate area ?

(4) Is the project likely to cause significantly higher rents or taxes in the immediate area ?

(5) What is the planned compensation programme for structures and businesses ?

(6) What are the attitudes and plans of people who must be vacated involuntarily to comply with code or zoning enforcement ?

(7) Will the project result in probable indirect displacement ? If so, have measures been planned to alleviate the hardship on those affected whose displacement is not covered under the compensation programme ?

c. Mitigation Measures

The related laws and regulations provide for assistance to individuals displaced by public acquisition. The developer and/or jurisdiction may be able to also provide assistance to those not covered by the Acts. Mitigation measures may include :

(1) Provision of an economic base for the displaced people.

(2) Help with moving expenses

(3) Helping people find new homes

(4) Publication of the full details of development and compensation well in advance to make it possible for people to start looking for another house and occupation in due course.

3. Transportation

a. Environmental Setting

Describe the existing transportation networks, mode of transportation, traffic volumes and composition of traffic as a function of the time of day. Consideration should be given to the site accessibility to employment, shopping and service areas for existing residents.

b. Assessment Questions

When considering transportation, the following questions should be asked :

(1) Will transportation facilities and services be adequate to meet the needs of the project's users ? Is off-street parking available and adequate ? Is adequate public transportation available ?

(2) Are there special transportation needs for the elderly and handicapped ?

(3) Will the project contribute to the cumulative effects of increased traffic in the metropolitan region ?

(4) Will the project provide bicycle and pedestrian systems to encourage lower car use in order to conserve energy ?

(5) Will the project create any safety hazards ? For example, have curbs been designed with wheelchair ramps, have pedestrian activated signal lights or pedestrian overpass been included in plans where needed ? Is traffic light timing adequate for elderly pedestrians ? Are road traffic speeds fitted to the new town area ?

(6) Will the project be provided with an adequate level of transportation service ? Will it overload existing or proposed transportation services or conversely, create a situation whereby facilities are seriously underused ?

c. Mitigation Measures

Some of steps which can be taken to mitigate transportation impacts are :

(1) Working with the local transit authority to add and/or reroute buses to serve the new project.

(2) Widening work of existing roads and/or construction of new roads to relieve the heavy burden placed upon the existing roads.

(3) Development of bicycle and pedestrian systems to provide access to nodal community structures.

(4) Including curb cuts and sidewalk designs suitable for wheelchairs.

(5) Installation of traffic signal controls including pedestrian activated traffic lights with timing intervals suitable for the elderly.

(6) Reduce and enforce road traffic speed.

4. Demography and Community Identity

a. Environmental Setting

Describe the demographic character of an existing commity in terms of household and population size, density, age, as well as income, education, and employment profiles. Describe the physical characteristics in terms of the quality and type of housing units, commercial, public and social services, its size, location and boundaries, identify the psychological and social interaction (or social balance) in terms of the residents' sense of neighbourhood, their perceived relationship with their surroundings and others within the neighbourhood boundaries, and the strength of their various organizational ties and support systems (formal and informal). Identify those structures and areas which have historic, cultural or architectural interest.

b. Assessment Questions

When considering the project's impact on demography and community identity, the following questions should be asked :

(1) Will the project involve a substantial alteration of residential commercial or industrial land uses ?

(2) Will the proposed project significantly alter the demographic characteristics of the neighbourhood ? The reasons for using a particular projection or forecast should be stated briefly.

(3) What are the factors which will contribute to the character of the neighbourhoods in the propsed project ? How may the proposed project change the community identity ?

(4) Will the proposed project result in physical barriers or reduced access which will isolate a particular neighbourhood or population group, making access to local services, facilities and institutions or other parts of the town more difficult or extremely inconvenient ?

c. Mitigation Measures

Desires of new-comers vary according to age, class, (income, education, etc.), and lifestyle. The physical plan must be flexible to allow for adaptation to change as time and demand vary. The social assumptions which are hypothetically established by planners should be re-examined based on empirical evidences (if available).

5. Public Facilities

Schools/Other Public Facilities

a. Assessment Questions

There are two fundamental issues : capacity and accessibility

(1) Will the additional school age children (or new users of other public facilities) in the proposed development exceed the capacity of the school (or other public facilities such as social services, emergency health care, fire station, police

station, commercial/retail, library, etc.)

(2) Do the potentially affected schools (or other public facilities) have adequate existing facilities (i.e., classroom space, buses for the projected population increase) ?

(3) Will additional or alternative facilities have to be provided to ensure adequate programs ?

(4) Will school children (or users of other public facilities) be required to walk or to ride longer than the suggested distances ?

(5) What measures will be taken by the superintendent or governing body to resolve potential problems (i.e. safety to users) ?

b. Mitigation Measures

While inadequacies in the school and other public facility systems can not be corrected by a project sponsor, there are steps that can be taken to ameliorate adverse conditions. They may include :

(1) Careful site planning to reduce hazards and improve accessibility, use of overpasses or underpasses and sidewalks

(2) Making sites available for future schools and other public facility construction.

Recreation and Parks

a. Environmental Setting

Identify the existing open space, recreation and cultural facilities on the site and site-adjacent areas. Determine how many of these sites are geared to residents/users.

b. Assessment Questions

(1) Will the proposed project overload existing in-door and out-door facilities on-and off-site ?

(2) Will the project involve creation of open space, recreational and cultural facilities within reasonable walking distance ?

(3) If the project includes special groups such as small children, or the elderly and handicapped, will be there convenient

facilities to meet their particular needs ?

c. Mitigation Measures

The developer in conjunction with the local government may consider:

(1) Expansion of existing facilities and provision of new facilities to reduce the burden caused by new users

(2) Review of design to create open space, recreational and cultural facilities within reasonable walking distance

(3) Review of design to mitigate project impacts on open space and cultural resources in the vicinity

(4) Development of recreational resources for specific population groups, such as tot lots for very small children, playgrounds for elementary school children, and passive park areas for the elderly.

6. Visual/Aesthetic/Attractiveness

a. Environmental Setting

Describe the area's general aesthetic quality. Where appropriate, discuss man-made objects and other items not handled elsewhere, and the overall "composition" mirrored by the total aesthetic picture. The visual quality of an area is made up of the way elements of the natural and built environment relate to each other to create a sense of harmony.

Elements that comprise the natural environment include the natural contours of the land, bodies of water, and trees and plants indigenous to the area. These elements together provide contrast to the built environment and create visual interest to the viewer. Elements of the built environment include the surrounding buildings and streets. The different styles and types of buildings and their materials, colours, shapes, sizes, façades, details and density, all add to the character of the area.

b. Assessment Questions

(1) Will the project introduce elements out of character or scale with the existing physical environment ?
(2) Will the project location, appearance, construction or activities which it will generate detract from the aesthetic appeal of its natural or man-made surroundings ?
(3) Are the approaches to the project convenient, adequate, safe, and attractive ?

c. Mitigation Measures

(1) Redesign site to separate or screen unsightly neighbourhood features
(2) Mass plant the contiguous property lines to provide a large scale "natural" barrier
(3) Provide tree planters strategically spaced in the parking lots to reduce the visual monotony of large ares of asphalt and rows of parked cars.

7. Archaeological and Historic Preservation

a. Environmental Setting

Describe historical and cultural or archaeological properties that are included in or eligible for the National Register of Historic Places. Identify a sense of place, character and image of a community.

b. Assessment Questions

(1) Does the project area and its environs contain any properties listed on the National Register of Historic Places ?
(2) Has a survey of local historic and cultural properties been conducted ?
(3) Does the Advisory Council on Historic Preservation need to be given opportunity to comment on properties which would be affected by the project ?

c. Mitigation Measures

If it is determined that the proposed project will result in an adverse effect on historic and archaeological resources, it will be necessary to examine ways to modify the project by various steps. They may include :

(1) Relocating the project away from historic, cultural or archaeological resources

(2) Modifying the project to avoid or minimize the adverse impacts through actions such as incorporation of the historic property for use by the project rather than a proposed demolition and new construction, or by a reduced scale or height of development on immediately adjacent lots

(3) Establish design review standards or procedures to be followed during project implementation. It may specify allowable actions and safeguard measures

(4) Relocating the register eligible property

(5) Recovering artifacts or archeological data or recording factual information on the site if there are no feasible alternatives to this loss or destruction.

8. Regional Development

a. Environmental Setting

Describe economic development (i.e. employment, income,), transportation and population according to the actual location of the project.

b. Assessment Questions

(1) Is the proposal consistent with complete components of the regional comprehensive plan ? Is the proposed project consistent with boards in a variety of functional areas ?

(2) Will the proposed project result in induced development which will alter the existing land use pattern ?

(3) Will the project cost and labour related expenditures benefit the regional economy ?

(4) Will the project aggravate the regional traffic congestion ?

(5) What are cumulative urban area effects resulting from both primary and secondary pollutants that can create large scale problems for a region ?

(6) What are the impacts of the total projected increase in population attributable to the project on the regional population and the rate of growth for the region ?

c. Mitigation Measures

Most regional impacts can be defined as induced (secondary, tertiary or tetrary) impacts. Some mitigation measures may include :

(1) Introduction of efficient traffic management to reduce the cumulative effects of increased traffic in a region

(2) Inclusion of the project site in the regional monitoring station networks.

VI. SUMMARIZATION OF TOTAL ENVIRONMENTAL IMPACT

The chapter on "summarization of the total environmental impact" should contain :

1. A systematic assessment of the results of the specific impact assessments in terms of an overall or summary evaluation.
2. A valuation of environmental, social and economic consequences of the proposed project as costs or benefits.
3. A rational integration of the major feasible mitigation measures with economic project appraisal. These measures should be added to project costs and benefits so far as possible.

In terms of quantification, a rule of thumb is that the consequences and their mitigation measures of the proposed project should be quantified in monetary terms, with a qualitative description prepared for the balance.

In addition to the narrative, the environmental impacts occurring in each environmental category should be displayed in a summary chart.

VII. ALTERNATIVES TO THE PROPOSED DEVELOPMENT

A. Alternatives

This section of the chapter on "Alternatives" should contain :

(1) A systematic development of all feasible alternatives for the solution of the identified new town development problems; and
(2) A rational comparison of all feasible alternatives, including the identification of critical differences leading to the selection of one (or more) alternative(s) over another.

Both the development and comparison should be presented in a clear and concise manner so that the reader can follow the logic of the Agency's decision-making process.

1. "No Project" Alternative

The environmental impact (short and long-term) without the proposed project should be discussed, so the reader can compare the impacts of the proposed action to this alternative.

2. Change in Intensity

Density alternatives should be presented for comparison with respect to the adverse impacts of grading, traffic, air pollution, water pollution, noise and demand on public services anticipated with the proposed project.

3. Change to a Different Type of Land Use

Different types of land use should be considered in the analysis with respect to compatibility with all surrounding land uses and the related plans etc.

4. Alternative Sites

Planning of the new town development should reflect criteria and other information contained in the Ministry of Construction(MOC) document on the "Guidelines for the Preparation of a City General Plan." Different locations for the new town development should be considered in the analysis. The selection of an alternative development site should be justified.

B. Project Justification

The proposed project should be justified on the basis of :

(1) Contribution to new town development goals and objectives (i.e., provision of high value housing, compatibility with existing land uses etc.)
(2) Present value or average annual equivalent value of capital cost and benefit for overall alternative and subsystem components
(3) Significant environmental costs and benefits of each alternative including a specific statement on future development impacts ; and
(4) Feasibility, reliability and flexibility of each alternative and any subsystems included in each alternative.

The major reason for favouring or rejecting an alternative should always be stated.

VIII. AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED

The participation of local, provincial, and central agencies, individual citizens and interested environmental groups in the preparation of environmental impact statements is of the utmost importance. Their suggestions, criticisms and objections should be given full consideration. The author(s) of each comment should be identified.

If soical surveys have been held, a summary of the survey should be appended to the EIS.

IX. BIBLIOGRAPHY

X. PREPARATION STAFF

Ⅱ. SURVEY RESULTS

A. Social Survey of a Village to be Displaced

1. Objectives of the Survey

The objectives of the survey were to provide information on :

(1) Some personal and domestic details

(2) Business organizations and other behaviour in the village

(3) Their attitudes and plans

2. Type of the Survey

An interview questionnaire survey was conducted since it was possible to conduct home interviews of a consolidated sample.

3. Questionnaire Design

Open-ended questions were designed. Preparatory work, including informal interviews with informed local people and planners and one pilot survey was conducted.

4. Perimeter of the Survey

The boundary of the investigation was defined as the Gwanmoon-Ri area since it was the only place which existed at the time of carrying out the survey.

5. The Selection of Respondents

116 people were interviewed. Only 106 households were included in the final analysis.

6. Carrying out the Survey

Interviewing for the main survey took place in May 1982.

7. Main Findings of the Survey

The summary of the main findings will be published in a separate paper.

B. A Social Survey of the New Town

1. Objectives of the Survey

The objectives of the survey were to provide information on :

(1) The characteristics of new-comers : their age, marital status, income, and occupation etc. ;
(2) Their activities - their work, recreation, shopping and other behaviour in the town ;
(3) Status of households and dwellings - their ownership and cultural facilities etc.
(4) Their attitudes, opinions and beliefs

2. Type of the Survey

An interview questionnaire survey was conducted since it was possible to conduct home interviews of a consolidated sample.

3. Questionnaire Design

Closed questions with some open-ended ones were designed. One pilot survey had been carried out before the main survey was conducted.

4. Perimeter of the Survey

The boundary of the investigation was defined as the areas of the 1st, 2nd phase developments and part of the 3rd phase development.

5. The Selection of Respondents

The stratified random sample was used and sampling consisted of :

(1) The factor/cluster analysis was conducted to obtain the

clusters which are of broadly homogeneous types of areas, using housing types, numbers of rooms, and heating facilities

(2) The target population was classified into clusters in the factor/cluster analysis

(3) Stratified random samples of addresses were drawn from within each cluster.

650 people were interviewed. Only 381 households and 1,442 people were included in the final analysis.

6. Carrying out the Survey

Interviewing for the main survey was conducted during the period from 26 December 1982 to 10 January 1983.

7. Main Findings of the Survey

The summary of the main findings will be published in a separate paper.