

CONTENTS

INTRODUCTION	3
THE NATURE OF THE PROBLEM	8
The Atmosphere and Pollution	10
Water and Pollution	12
The Land and Pollution	13
LEGAL, LEGISLATIVE, AND INSTITUTIONAL PROBLEMS	15
Legislation and Pollution	15
Institutional Patterns and Pollution	17
AREAS OF INADEQUACY	18
Technology—Known and Unknown	19
Constraints on Existing Technology	19
Research and Education.	20
POSSIBLE IMPROVED APPROACHES	22
Available Basic Methods	22
Auxiliary Techniques	23
Public Policy and Institutional Arrangements	24
RECOMMENDATIONS.	26

APPENDIXES

1. POLLUTION PROCESSES IN ECOSYSTEMS	31
Summary	31
Introduction	34
A Definition of Pollution	35
Ecosystems	36
Processes and Zones of Accumulation	38
The Soil	38
The Water	42
The Air	51
Planning	56
Management of Pollution	56
Economic Factors	58

Health Aspects	60
Regional Design	61
Conclusions and Recommendations	61
2. CRITERIA, INSTRUMENTATION, AND MONITORING	64
Introduction	64
Regulation	64
A Sense of History	65
Water	66
Historical Aspects.	66
Definitions and Problems.	66
Regulation and Policy	68
Human Health	69
Fish and Wildlife	70
Industrial Use	71
Ground Water Supplies.	72
Criteria, Pollution, and Quality	73
Standards	74
Air.	76
Introduction.	76
Industrial Problems	77
Vegetation Effects.	78
Air Pollution: Health	80
Radiation and Health.	82
Land	83
Incineration Problems	84
Sanitary Landfill	85
Agricultural Lands	86
Summary: Solid Waste	87
Instrumentation and Monitoring	88
Introduction	88
Water Monitoring	89
Air Monitoring	89
Land Monitoring.	91
Summary and Conclusions.	92
3. THE TRANSPORT SYSTEM.	95
Introduction	95
Natural and Modified Systems	95
The Fresh-Water Resource	97
The Atmospheric Resource	110
Natural Dispersion System	110
Natural Pollutant Loadings	111
Artificial Pollution	113
Ventilation Constraints	114
Saline-Water Resource	115
The Air-Saline Water Interchange	115
The Land-Saline Water Interchange	115
The Fresh-Water-Saline-Water Interchange	116
The Land Resource.	116
Air-Land Interchanges	117

Water-Land Interchanges	117
Land-Land Interchange	118
Areal-Interchange Analysis.	120
A Concept of Areal Interchange.	121
Possibility of a Systems Approach.	121
Atmospheric Ventilation	123
 4. THE RESIDUE SITUATION—CURRENT AND FUTURE	126
Introduction	126
Residue Magnitudes and Effects	126
The Atmosphere—Current	126
The Atmosphere—Future	129
The Land	130
The Waters	136
Institutional Characteristics	144
The Air Environment	144
The Land Environment	148
The Water Environment	150
Status of Technology	154
General	154
Historical Development	154
Status and Inadequacies	157
Instrumentation and Monitoring.	159
Technological Capability to Control.	161
Present Restraints to Application of Existing Technology	171
Conclusions.	172
Air	175
Land	176
Water	177
Recommendations	178
 5. POLLUTION-ABATEMENT TECHNOLOGY	181
Summary	181
Conclusions.	185
Water	186
Origin and Nature of Pollutants	187
Quantities and Characteristics of Waste Waters	187
Effects of Pollution on Receiving Waters	189
Cost of Water Pollution Abatement	190
Quality Standards.	191
Present Technological Capabilities	191
Possible Future Technology	194
Land	196
Air	199
Sources of Emissions	199
Economic Impact of Air Pollution	201
Technological Capabilities.	201
 6. LEGAL AND PUBLIC ADMINISTRATION ASPECTS	203
Summary	203
Introduction	205

Optimizing Methods: Benefit-Cost Analysis and Systems Design	207
A Model of Regional Water-Quality Management: The Delaware River Basin Commission	209
The Common Law. Administrative Regulation. and Formal Government Bodies.	212
The Formalist Model: Some Virtues	214
The Formalist Model: Some Deficiencies	216
Conclusion: Problems. Difficulties. and Aspirations	218
Areas for Research in Legal and Public Administration Aspects	220
7. PUBLIC POLICY AND INSTITUTIONAL ARRANGEMENTS.	222
Introduction	222
Nature of Decision Making	222
Limitations	224
Criteria	224
Proposals for New Policies and Institutional Arrangements	225
Organization and Conduct of Public Operational Programs	225
Organization—The Problem Shed.	225
Organization—The Federal Government	226
Organization—The States	227
Organization—The Urban Area	228
Proposed Policies to Guide Public Operational Programs.	228
Research and Measurement	230
Legal Institutions and Arrangements	231
Private and Public Rights. and the Role of the Court	231
Proposed Judicial Changes	233
Experimentation with Sanction and Incentives	234
Manpower and Education of the Public	234
Recommendations	235
8. A BRIEF ANALYSIS OF POLLUTION IN THE DELAWARE ESTUARY	237
Introduction	237
Air	240
Motor Vehicles	240
Public Electric Utilities	241
Water	244
Biological Oxygen Demand—Municipal	244
Biological Oxygen Demand—Industrial	244
Phosphates. Nitrates. and Silt	246
Heat	246
Land	249
Refuse	249
Summary	249
BIBLIOGRAPHY.	252
NOTES CONCERNING THE APPENDIXES.	253
LIST OF PARTICIPANTS	255