



Project Summary

Reclamation and Redevelopment of Contaminated Land: Volume II. European Case Studies

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The Research Triangle Institute (RTI) began work for the U. S. Environmental Protection Agency (EPA) in 1983 to investigate contaminated sites in the United States where cleanup measures have been carried out to enable specific redevelopment of a site. This work resulted in a report issued by EPA in August 1986, documenting 16 uncontrolled hazardous waste sites. Case studies presented land use history and redevelopment objectives, the nature of the contamination, descriptions of the remedial actions undertaken, the planned upgraded reuse of the property, and the criteria for cleanup.

During the course of the study of U.S. sites, it became apparent that contaminated land reclamation and redevelopment were of international interest. Thus, the EPA study was extended to include experiences in certain European countries. This report presents highlights of programs dealing with contaminated land in England, Wales, Sweden, the Netherlands, and then the Federal Republic of Germany.

This report is a companion document to the August 1986 EPA report addressing reclamation and redevelopment in the U.S. (EPA/600/2-86/066).

This Project Summary was developed by EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

There are numerous instances in the United States and Europe where uncontrolled dumping or industrial spills have contaminated properties with hazardous materials. Since many of these properties are in prime urban locations, issues surrounding the reclamation and redevelopment of contaminated sites have become important international topics. This report documents experience in reclamation and redevelopment at selected contaminated sites in England, Wales, Sweden, The Netherlands, and the then Federal Republic of Germany. Much of the information is drawn from interviews with various government officials and local authorities from each country who are responsible for overseeing and implementing the contaminated land activities related to reclamation and redevelopment.

Interviews and site visits were conducted during February and March of 1985. Additional information was subsequently received through correspondence with various individuals previously contacted in Europe. The report is current through April 1985 with certain portions updated through 1987 and early 1988. The report does not critique or judge any country's program or compare European approaches to approaches applied in the U.S. The objective is merely to extend the information base pertaining to contaminated land reclamation actions undertaken for specific land reuse.

The study addresses site assessment and reclamation programs, available funding sources, and guidelines established to



assist reclamation. The reclamation and redevelopment experience at selected sites in each country is described in detailed case studies. Each case study describes the land use history and redevelopment objectives, the nature and extent of the contamination, remediation activities, site reuse, and criteria for cleanup.

Discussion

England, United Kingdom (U.K.)

England is one of the most industrialized nations of the world and has a population density about 15 times higher than that of the U.S. As a result of this industrialization and urbanization, the potential problems associated with the redevelopment of contaminated land were recognized earlier in England than in the U.S.

Several legislative Acts of Parliament provide the framework for dealing with contaminated land in England and Wales. The Derelict Land Act of 1982 encourages the redevelopment of contaminated and derelict land, particularly where private sector development will result. The disposal of all controlled material, including surplus excavated material from redevelopment sites is regulated under the Control of Pollution Act of 1974. Site licensing is the primary means of regulating the disposal of all controlled wastes. The Town and Country Planning Act of 1971 empowers local authorities to control most forms of development including development of contaminated land.

Within Central Government, the Department of the Environment (DOE) sets environmental policy for England and Wales and is responsible for implementing the programs related to the various environmental legislative Acts. The Central Directorate on Environmental Pollution (CDEP) within the DOE is mainly responsible for dealing with issues involving contaminated land and advising local authorities.

The Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) was established in 1976 to coordinate government activities and advice relating to contaminated land. The ICRCL includes representatives of several British government departments. A basic objective of the ICRCL is "to restore contaminated land to beneficial use economically". The ICRCL has developed a series of Formal Notes to address redevelopment at landfill sites, sewage works and farms, gas works sites, and scrap yards and similar sites.

One of the tasks carried out by the CDEP for the ICRCL is an effort to develop guidelines pertinent to contaminant

levels at sites where redevelopment is being considered. In 1983, the ICRCL issued guidance for local authorities and prospective developers on assessing and redeveloping land that has been contaminated by its former use. This guidance included "Tentative Trigger Levels" to serve as criteria for comparison with specific contaminant levels in soils. The applicable concentrations vary with the proposed use of a site. The Tentative Trigger Concentrations are reviewed and updated periodically by the ICRCL. The guidance issued with the trigger concentrations stresses the importance of an adequate investigation of the site prior to applying the assessment criteria.

Methane or other combustible or explosive materials are present on many sites being considered for redevelopment. The assessment of fire and explosion hazards of contaminated land is an important program aspect of the CDEP and the ICRCL. The ICRCL has developed "Notes on the Fire Hazards of Contaminated Land."

The Greater London Council (GLC) was established in 1965 to be responsible for London fire service, refuse disposal, highways and traffic planning, and structure planning. Until abolition in March 1986, the GLC had absolute control over planning for Inner London and strategic planning control for outlying areas. The GLC also coordinated efforts to bring derelict land into beneficial use.

The GLC in 1979 suggested guidelines for use during site assessments to define various levels of soil contamination. The degree of soil contamination is classified as "uncontaminated," "slight contamination," "contamination," "heavy contamination," or "unusually heavy contamination." The ranges of contaminant levels corresponding to the various classifications are based on comparison with typical "uncontaminated" soils rather than on an assessment.

The case studies for England are the Corby Steelworks in the town of Corby in Northhamptonshire in the English Midlands; the Wandsworth Gas Works, London; and the planned community of Thamesmead on the Thames River in London. Experience at these sites illustrate the manner in which certain problems were dealt with during site reclamation and redevelopment.

The Corby Steelworks operated from the 1930's until 1979. When the steel mill closed, the Corby district Council acquired the steelworks site for redevelopment. At several tracts of land formerly occupied by the steel works (or its ancillary operations), site reclamation to deal with contamination had to precede any redevelopment

activity. Chemical contaminants found in the various areas of the former steel mill property included heavy metals, cyanides, sulfur salts, naphthalene and other volatile organics, coal tar, various oily wastes, phenols and asbestos. The site reclamation plan was developed on the basis of a detailed site assessment to determine the extent of the contamination. Guidelines developed by the Greater London Council (GLC) were used in the assessment.

Future use plans for the reclaimed steel mill site focus primarily on industrial development that will provide jobs. The fact that the sites offered in Corby are, in many cases, reclaimed contaminated land does not appear to have any influence on the attractiveness of the redevelopment properties.

The Wandsworth Gas Works produced gas from coal for about 100 yr. The gas works site extended some 550 m along the Thames River. Parts of the site were reclaimed from river marsh by filling with process wastes such as spent iron oxide from gas cleanup. The site was purchased by the GLC for development as housing. Based on findings of extensive contamination in site assessment in 1976, the GLC determined that redevelopment of the site should be for less sensitive land use. Contamination from coal tar is believed to pose the most serious potential hazard at the site.

Disturbing the buried foundations, tanks, pipelines, pits, and other structures was considered to pose a major pollution problem and a direct exposure hazard to workers. Because of these problems, the GLC recommended, "reduction of site disturbance to the minimum possible." Sufficient remedial work was carried out in 1983 to insure that contamination from the gas works did not pose a hazard to the surrounding areas. Portions of the site are scheduled for redevelopment for light industry to provide jobs in the area. A refuse transfer station has been constructed on a 20-hectare (49 acres) tract at the western end of the site. Remedial measures must precede any redevelopment of the remainder of the site occupied by the gas works.

Some 400 hectares (988 acres) of the Thamesmead development are on the site of the former Royal Arsenal in Woolwich. The extent of the contamination from the old arsenal activities was first recognized in 1975. Chemical contaminants of concern at site include heavy metals, coal tars, oils, phenols, sulfur salts, free and complexed cyanides, combustible materials and asbestos. For the purposes of development, the Thamesmead site has

been divided into a number of areas, each with its own characteristics and planned use. About 40 % of the site had been developed by 1985. When complete, Thamesmead is planned to accommodate some 40,000 people, including homes, recreation and shopping, and local employment on purpose built industrial estates. Recommendations for remedial measures are proposed based on projected long-term hazards to site users.

Wales, United Kingdom

The Principality of Wales is politically united with England, and the two countries have shared common systems of law and government for nearly 450 yr. The legislative Acts of Parliament effective in England also apply to Wales. The largest category of derelict sites in Wales involves coal wastes. Because so little land in Wales is suitable for development due to the steep slopes, there is pressure to develop any unused land, particularly in or near towns, and to reclaim derelict land. In the narrow valleys characteristic of the mining areas, level ground is primarily occupied by surface works, and mining wastes are tipped on the valley sides.

The Central Government of the U.K. establishes environmental policy in both England and Wales. The role of the Welsh Office in Wales is analogous to the role of the DOE in England. The Environmental Protection Division within the Welsh Office, Cardiff, is responsible for administering the environmental programs in Wales including programs pertaining to contaminated land.

The Welsh Development Agency (WDA) is empowered to make grants to County and District Councils for the purpose of reclaiming derelict land. The costs required to bring such sites to a "greenfield" state are eligible for these grants. The WDA also engages in site redevelopment.

In 1983, the Welsh Office and the WDA co-sponsored a survey of sites that are believed to be contaminated. Emphasis was placed on contaminated sites of 0.5 hectares (1.2 acres) or larger; sites currently in beneficial uses were excluded. More than 700 sites were cataloged during the initial survey, and additional updates and expansion of the data base are planned.

The Lower Swansea Valley near the south coast of Wales is described in detail in a case study. From the beginning of the 18th century, the port of Swansea was an important shipping outlet for coal from the South Wales Coal Field. The Lower Swansea Valley became a major center for smelting of copper, zinc, and other metals and later for steel and tin

plate production. The heavy industrial activity in the Valley ceased after World War II, leaving the Valley in a polluted, derelict state. It was estimated in 1964, that approximately 12 hectares (400 acres) within the Lower Swansea Valley were covered by waste tips containing some 5 million tons of industrial waste containing high levels of copper and zinc as well as antimony, arsenic, cadmium and lead.

The Lower Swansea Valley Project was initiated in 1961 to address the dereliction and contamination in the Valley and to begin the planning for future development. Among the recommendations of the project that influenced later work were: An accurate and detailed base map, visual improvements through planting trees and grasses, statement of the need for a single body to acquire all the land to be redeveloped, and planning for the Valley that included housing and recreation as well as industry.

The first major reclamation schemes were undertaken beginning in 1966 when Swansea was designated a Development Area, qualifying the area for financial assistance from Central Government to reclaim derelict land for industrial development. The policy was to clear the derelict land, return the land to active use, and encourage new and modern industry to the area.

By 1974, the Local Authority had acquired some 330 hectares (815 acres) of land and the reclamation programs were substantially complete for 172 hectares (425 acres). Additional land clearance, reclamation, infrastructure, amenity planting, and industrial promotion were carried out between 1974 and 1983 supported by grant aid from the WDA, and other sources.

Sweden

The Ministry of Environment and Energy is responsible for environmental programs throughout Sweden. Environmental policy is implemented through permits and National physical planning. Environmental issues are among the highest rated priorities of the Swedish general public. Except for some sites in metropolitan areas, however, the reuse of contaminated land in Sweden has not been a major focus of concern.

The Central Organization of Swedish Communities has completed a national inventory of oil dumps and landfills. In all, 3,800 properties have been registered including about 500 that are believed to represent a potential threat to man and the environment. High priorities have been assigned to about 20 dump sites.

Two sites are addressed in case studies. These are the Augustendal Dumpsite in Nacka, a suburb of Stockholm, and the BT-Kemi Pesticide Plant, near Malmo, in Southern Sweden. The cleanup of the BT-Kemi site was the first remedial action project in Sweden.

The Netherlands

The Netherlands is the most densely populated country in Europe. The Netherlands is also a highly industrialized nation, smaller than the State of New York. Metal manufacturing (iron, steel, aluminum) and, in more recent years, the chemical industry are the most important industries. The Netherlands is a parliamentary democracy under a constitutional monarch.

Because of the scarcity of land in the Netherlands, every site is needed. Many sites, particularly in the municipalities, have been used for many decades and for more than one type of use. Contaminated land in The Netherlands is viewed as a very serious problem because of the high population density, the relative scarcity of land, the high water table in many parts of the country, and the reliance on groundwater from drinking supplies. Protection of groundwater is of special concern in the Netherlands.

A survey of contaminated sites in 1980 identified more than 4,000 potentially contaminated sites. In 1981, about 350 investigations and 30 cleanup operations were started at a cost equivalent to about 20 million U.S. dollars. In 1985, it was estimated that urgent cleanup measures were needed at 1,170 sites. The major types of contaminated sites identified are waste dumps, former factories and manufacturing plants, former gas works, and other sources.

The Soil Protection Bill which became law on Jan. 1, 1984, provides for a 5-yr program of measures aimed at protecting the soil. The program is to be overseen by the Ministry of Housing, Physical Planning, and the Environment. The policy regarding soil protection is that the soil must retain its ability to perform a wide variety of functions adequately. The creation of ground-water protection areas is a short-term policy objective.

Under the Soil Cleanup (Interim) Act, which came into force in January 1983, the Provincial Authorities are required to submit each year to the Ministry of Housing, Physical Planning, and the Environment, a cleanup program to deal with soil contamination. A cleanup program runs for a period of 5 yr and covers all instances of severe soil contamination within each province. Each province, in consul-

tation with the Municipal Authorities develops priorities for site cleanups. The Minister determines which cases are to be considered for remedial measures or investigations with Central Government assistance.

The Soil Clean-Up Act was later incorporated in the Soil Protection Bill. Cleanup costs are shared by central government, the provinces, municipalities, and certain industries. The Ministry of Health and Environmental Protection normally contributes approximately 90% of the cleanup operations. In some instances, an industry is responsible for paying the cost of cleanup, and the government will collect the payment from the responsible party after the cleanup is completed. The Central Government has budgeted equivalent to about 700 million U.S. dollars for the program over a 15-yr period to provide for site clean-ups and also for the Central Government's program in research, standards development, analysis, and coordination to insure consistency in the cleanup efforts.

The Ministry of Housing, Physical Planning, and the Environment (1983) has developed guidelines to be used in site investigations to assess the degree of contamination. Soil contamination means there is a chemical in the ground exceeding the level normally expected to occur. Constituents for which the guidelines are developed are recognized as indicators of pollution.

The capacity of cleanup installations in The Netherlands is insufficient to treat all the excavated contaminated soil from site cleanups. As a result, storage of a considerable amount of material is necessary while awaiting processing. It is estimated that The Netherlands has 1.5 million tons of contaminated soil from old gas works and an even greater quantity of soil polluted with oil.

The contaminated land problem in the Netherlands first came to public attention in 1978 with the discovery of serious soil contamination near homes in the town of Lekkerkerk. The contaminated area (8.9 hectares [22 acres]) underlies 268 houses.

Excavations in the area revealed chemical waste buried in containers and in bulk in trenches and pits. The wastes deposited at Lekkerkerk originated at a variety of industries including the building industry, paints and varnish manufacture, paint spraying, plastics manufacture and processing, chemical industry, and printing ink manufacture and application. Soils adjacent to the buried wastes were also polluted. Pollutants were found beneath houses, just below the floor.

The remediation activities involved the excavation and removal of 93,800 m³ of contaminated soil. This material was processed in a domestic refuse incinerator at Rotterdam.

No polluting materials were allowed to remain at Lekkerkerk. The total cost of the remediation work at Lekkerkerk amounted to about 65 million U.S. dollars, paid by the Netherlands Central government. If Lekkerkerk were discovered today, the remedial action for the site would likely be very different as the cost of such a program cannot be justified (\$242,000 per house).

Other case studies of contaminated sites in the Netherlands include Delfshave, an older area of Rotterdam Harbour where a special infilling technique is being used to provide land for housing; Merwedepolder, Dordrecht, where remedial action was undertaken after a housing development was built over a former chemical waste dump; and the Tilburg Gas Works where extensive excavations were necessary to reclaim the site for housing.

The Tilburg Gas Works produced gas from coal for more than 100 yr on a 5.5 hectare (13 acres) site that is now in central Tilburg. The plant also produced coke as well as byproduct tars, benzene, toluene, naphthalene, and ammonia. Site investigations were carried out in 1982. Available maps and site history were studied to identify areas where contamination was likely to be most concentrated. Samples were taken both at the surface and at depth on a 10 x 10 m grid. Chemical analyses revealed the presence of volatile aromatics, polynuclear aromatic hydrocarbons, and cyanides. Tar and oil products polluted large areas to a depth of 4 m. The pH of water at the site measured 2.5 due to the presence of hydrogen sulfide. Coal and sinters covered several acres of the site.

The remediation work was carried out during the winter 1984-1985 and in October and November of 1985. The excavations were performed during the winter in order to minimize worker exposure to volatile contaminants. During the winter 1984-1985 a total of 28,186 m³ of polluted soil were excavated and transported off-site for temporary storage and thermal treatment.

Guidelines from the Ministry suggested that contamination should be cleaned up to background levels. All detectable pollution to a depth of 2 m was removed. Excavations were also carried out to lower depths (below the water table) to reduce contaminant levels and to minimize further contamination of the aquifer.

Federal Republic of Germany

The Federal Republic of Germany (FRG) before German unification of October 1990, was somewhat smaller than the state of Oregon in the U.S. and had a population of just over 61 million people. The country included 10 states plus the territory of Berlin. The individual states (Länder) enjoyed considerable political autonomy.

The Federal Environmental Agency, Umweltbundesamt, headquartered in Berlin was responsible for establishing basic environmental policies for the FRG, although the individual Länder implemented their own programs. The Federal Waste Disposal Act, issued in 1972, required wastes to be disposed of in a way that avoided environmental damage.

The German word "Altlasten" (meaning old burdens) is used to refer to environmentally hazardous waste disposal problem sites. Although the total number of sites containing hazardous materials is quite large, the subset of waste disposal problem sites was estimated in 1983, to be less than 1,000. Investigations and possibly remedial action is needed at these sites.

Although there are no official guidelines to assess soil contamination in the FRG, threshold levels for certain heavy metals are recognized based on average levels found in soils. These normally occurring and acceptable levels derive from a literature search and recommendations published in 1977.

The discussion of reclamation and redevelopment in the then FRG addresses three different areas: The City-State of Hamburg, the Ruhr district, and the Central and South Regions. The programs for environmental planning reflect the very different geographical features of these areas. The concerns in Hamburg, a city of over a million people, differ from the issues of the Ruhr district which is marked by many small to medium-sized industrial towns located adjacent to each other. The Central and Southern regions include substantial rural areas as well as several very large industries.

The Ruhr District (Ruhrgebiet) in the state of Nordrhein-Westfalen is perhaps the largest industrial area in Europe. Environmental problems associated with the residue from more than 100 yr of heavy industrial activity (i.e., coal industry, iron and steel working, chemicals manufacture) are prevalent throughout the Ruhrgebiet. Contaminated land in the Ruhrgebiet is often reclaimed for new industrial use, but with stringent controls aimed at softening the environmental impacts on the region.

Five sites are described in case studies. The Havighorster Moor site, in Hamburg, was used as a dumping area after World War II. After arsenic contamination was found in a nearby stream, an extensive cleanup operation was undertaken by the State. The source of the arsenic contamination was removed to a permitted facility or isolated in a specially designed pit on-site. After the cleanup was completed, new problems at the site became apparent. Low levels of chlorinated organics were found in water seeping from the site. A new remediation scheme has been planned to treat the contaminated water using an aquatic plant (*Phragmites communis*).

At the site in Bielefeld in the Ruhr District, buried industrial waste has been discovered in a housing development. Methane resulting from municipal waste formerly dumped at the site is also of concern. The town has offered to purchase the homes of any owner who wishes to relocate.

At an industrial site in Dortmund, a major cleanup is underway in which contaminated soil and water are mixed with lignite fly ash in a patented process. The resulting mixture hardens to a concrete-like mass and is disposed on-site in a lined pit.

Additional case studies describe the remedial actions at an urban site contaminated with diesel fuel and an industrial site where residues from Lindane production were deposited.

Conclusions

The Role of Central Government

In each country the central government is responsible for formulating policy regarding the cleanup of contaminated sites. The actual cleanups, however, are carried out by local authorities in most instances. Government regulations are established in each country to control the disposal of contaminated materials. The Central governments in Wales, Sweden, and the Netherlands have conducted surveys of contaminated sites to assess the extent of contaminated land. Efforts were also made to prioritize sites based on their potential impacts on people and the environment. Such surveys in England and in the then FRG have been limited to specific regions or municipalities.

Of the cleanup efforts investigated for this report in England, Wales, and the Netherlands, almost all were financed through funding programs made available through the Central Government of the

respective country. In most cases, a small percentage of the total rehabilitation cost (typically 10%) is borne by local governments.

Very Large Sites

Three sites that are treated in detail in case studies encompass areas exceeding 100 hectares (247 acres). These are Thamesmead, London, England; Corby Steelworks, Northhamptonshire, England; and the Lower Swansea Valley, West Glamorgan, Wales. Although each of these sites is subdivided into many smaller areas for specific reclamation work, the success of the various individual reclamation and redevelopment efforts is dependent on the overall reclamation scheme for the area. Common ownership by a single authority and a coordinated master plan for site reclamation have been vital to the success of the redevelopment of these areas. Because the quality of contaminated soil and debris is so great at these large sites, the cost of complete removal of the contaminated material would be prohibitive. The master plan for reclamation and redevelopment at these sites includes contaminant areas for on-site disposal of large quantities of contaminated materials.

Response When Contamination Impacts Current Land Use

At three of the sites addressed in case studies, the remedial actions were prompted by concern over potential adverse health effects from exposure to contaminants present in the ground beneath private homes. The local municipalities were considered responsible for the developments since they had granted planning permission for the developments in spite of the buried waste. The remedial efforts at Merwedepolder and Brake were still being discussed in 1985. At Lekkerkerk, all buried waste and contaminated soil were removed from the housing area. At Brake and Merwedepolder, the local authorities offered to purchase, at market prices, all the houses affected by the buried waste in order that the people might relocate. Although the presence of toxic materials near homes at Lekkerkerk, Merwedepolder, and Brake is clearly established, there is no medical evidence of serious adverse effects from exposure in any of the inhabitants.

Redevelopment of Gas Works Sites

Former gas works sites are frequently encountered in Europe. Before the turn of the century, gas works were in opera-

tion in virtually every major city and town and the plants were usually centrally located for ease in distribution. Besides production of coal gas, coking and byproduct refining operations were associated with chemical industries and steel making. Most of the gas plants ceased operation in the 1950's as gas from the North Sea wells became available. The contaminants present at these types of sites include coal tars (which contain polycyclic aromatic hydrocarbons that are recognized to be carcinogenic in animals), aromatic solvents (benzene, toluene, and xylenes) phenolic compounds, free and complexed cyanides, sulfides, sulfates (aggressive to building materials) and combustible materials.

Many of the former gas works sites have been acquired for redevelopment by local municipalities because of their central locations. In some instances, the extent of the contamination at a gas works site was not recognized before redevelopment plans were made. Plans for sensitive reuses (e.g., school, housing) have had to be abandoned in light of site assessment findings. In some cases, (e.g., Thamesmead, gas works site) the site assessment led to the conclusion that it was best to allow the contaminated site to remain undisturbed. Factors leading to such a conclusion include: Uncertainty as to the extent of excavation necessary to ensure that future users of the site would not be exposed to chemical contaminants, the high cost and the uncertainty of the cost to carry out the site reclamation, and worker safety during site excavation.

The Problem of Extremely Hazardous Waste

The disposal of dioxin-contaminated waste poses a serious problem throughout Europe. No satisfactory means for its disposal has been approved in Sweden or Germany. Until there is a safe, approved method for destruction or disposal, storage of the material must continue. As the volume of stored dioxin-contaminated waste increases, so does the likelihood of accidental release and exposure. An important need for the European community is an inventory of the stored dioxin waste, an estimate of the extent of such waste that remains buried, and an agreement regarding the final disposal or destruction of dioxin wastes.

On-Site Disposal Versus Removal

Only a few sites were encountered where waste is being treated for disposal

on-site. One such site, the industrial site near Dortmund, involved on-site treatment of contaminated waste and soil. Soils were treated by mixing with brown coal fly ash. The mixture hardens as it cools and the solidified material retains the contaminants, even if exposed to water. At the B.T. Kemi site in Sweden, a forced leaching technique was applied to remove chemicals (phenoxyacids) from low and medium contaminated soils. At all other sites, the cleanups involved excavation followed by treatment and/or disposal at licensed off-site facilities for most highly contaminated waste and soil. Less se-

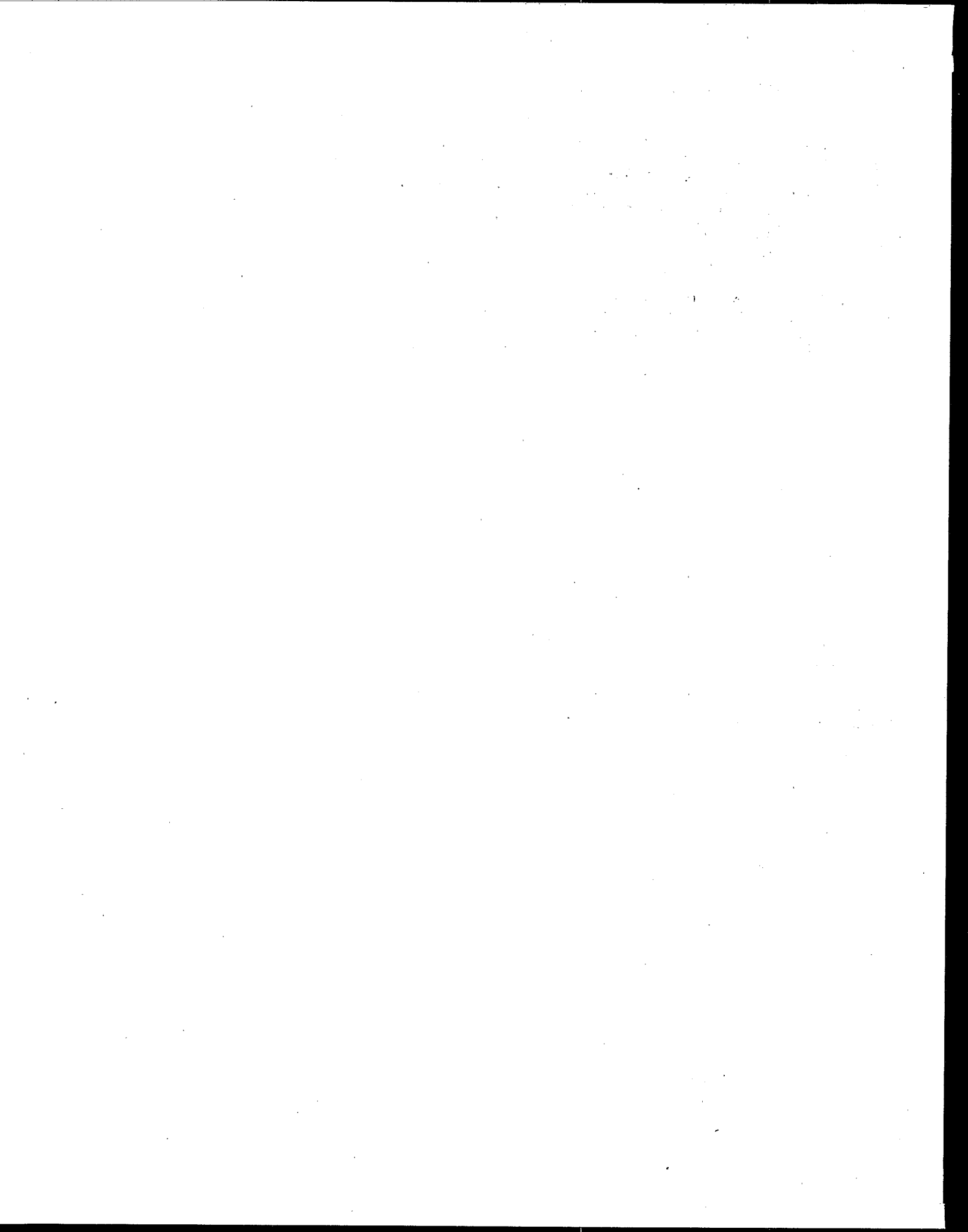
verely contaminated material (a notably subjective description) was usually disposed in a semi-isolated, on-site cell.

Criteria for Cleanup

None of the countries addressed in this report have established statutory limits for contaminants in soil, nor are there generally applicable rules for determining whether a given site is suitable for a specific use. Guidelines have been developed in England and in the Netherlands to be applied in site assessments when contaminated soil is encountered. In England, the guidelines, called Tentative Trigger Concentrations, developed by the

ICRCL, are recognized for site assessments throughout the U.K. The Trigger Concentrations pertain to specific contaminant levels in soils below which a site could be regarded as uncontaminated. In the Netherlands, soil assessment levels are recommended by the Ministry of Housing, Physical Planning and the Environment. These guidelines all emphasize the importance of site investigations and assessments.

Protection of groundwater is of foremost concern in the Netherlands and in the then FRG. A large portion of drinking water in these countries is taken from groundwater.



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*The complete report, entitled "Reclamation and Redevelopment of Contaminated
Land: Volume II. European Case Studies," (Order No. PB92-146 166/AS; Cost:
\$35.00, subject to change) will be available only from:*

National Technical Information Service

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