ered a treatment, it cannot be assumed to detoxify all contaminants. A treatability study during the design phase should be limited to obtaining data necessary for the detailed, engineering design of the selected technology and also to develop technical criteria to guide potential bidders on the project. If a treatability study is necessary to show effectiveness, as in this case, then it should be done, as it sometimes is, during the RIFS process. If it is delayed, then "Such a deferral may result in a premature (and administratively 'irreversible') commitment to a technology that may not be appropriate for a given site." (D. Truitt and J. Caldwell, "Evaluation of Innovative Waste Treatment Technologies," Waste Management ***Conference-Focus on the West,*** Colorado State University, June 1987.)

The selected remedy for Chemical Control can be considered a land disposal/containment approach. OTA does not mean to challenge the merits of the in situ chemical fixation technology but does question the decisionmaking process used at this site. Making the remedy selection before treatability test results are available may mean that EPA was in a hurry to promote innovative treatment technology and to issue the ROD.

The ROD also did not assure a permanent remedy for the site because it ignored the cleanup of the highly contaminated river sediments, ignored the contamination in the gravel, and ignored the untreated material at the river's edge. The ROD over estimated the cost of onsite incineration, which could achieve more permanent, more complete, and more certain cleanup at a cost of about $14 million, instead of the ROD's $22 million estimate.

The serious complication of other nearby sources of contamination shows that Superfund sites cannot be seen in isolation. The ROD noted that recontamination of the site is a p~tential problem. Therefore, a case could have been made for coordinating this cleanup with others to assure an overall, permanently effective solution for all of them.

There seems to be an unusual interest in the RIFS and ROD process in reusing the site and constructing something on it, despite the uncertainty of the selected cleanup, despite the contaminated materials to remain onsite, and despite the other nearby sources of contamination. The FS indicated that the State of New Jersey owns the land and that, with the selected remedy, New Jersey's own law regarding real estate transfer would be violated if the site was put into commercial reuse "Since some residual contamination will exist in the gravel cover under [the selected remedy], and since the subsurface contamination will still be present (although immobile), it is unlikely that this alternative ,will comply with the concentration requirements of ECRA [New Jersey's Environmental Cleanup Responsibility Act]. It is felt that this alternative will be consistent with the intent of ECW, however." The FS noted a cancer risk above 1 in 1 million for contact with the contaminated gravel, a risk that has implications for future use of the site and onsite workers.

Case Study 2
Compass Industries, Tulsa County, Oklahoma; EPA Region 6

Capsule OTAfindings.-Capping (containment) of waste was chosen over incineration, capping was called a cost-effective, permanent cleanup even though it does not provide permanent protection co~arable to incineration. Treatment of contaminated groundwater is not yet planned.

Kay **datas:**

- Entered Superfund system: 10/1/80
- preliminary Assessment: 4/1/80
- Site Inspection: 7/1/82
- National Priorities List
  –proposed date: 9/83
  –final date: 9/84
  —site rank: #483 out of 770
- RIFS start and completion: 6/29/84- 7/13/87
- Public comment period before Record of Decision: 7/22/87 - 8/31/87
- Signing of ROD: 9/29/87
- Estimated complete remediation: 9/90

Totai time.—IO years

Brief description of site.-The site is" . . . an abandoned landfill located west of Tulsa, Oklahoma. The site occupies an abandoned limestone quarry. From 1972 to 1976 the site was permitted and operated as a solid and industrial waste landfill. physically, the site is situated on a bluff approximately one-quarter mile south and zoo feet above the Arkansas River. An elementary school lies within one-half mile and a major regional park is immediately adjacent to the site."

Major contamination/environmental threat.—" . . . a large number of organic and inorganic priority pollutants were detected. They include a total of 12 inorganic priority pollutants and at least 33 organic priority pollutants . . . pathways of possible off-site contaminant migration are surface water, groundwater, and air. The possibility also exists for direct contact at the site with contaminated source materials, such as sludge, soil, or sediments. The majority of the contamination in the groundwater is confined to the upper aquifer. Samples of groundwater from monitoring wells on the site are highly contaminated. This indicates a degradation of groundwater quality due to waste disposal in both the perched and deep aquifers. The volume of waste was determined to be approximately 620,000 cubic yards. The average groundwater flow rate of both aquifers is 720 gallons per day or an estimated 263,000 gallons of water per year [into Arkansas river]. The most recent fire burned for several years before it apparently burned out in 1984. . . . there exists a potential for future fires. . . . [During fires] elevated levels of air contaminants may present a health hazard."

HRS scores .—groundwater 11.05; surface water 18.46; air 59.49; total 36.57

Removai actions.—None indicated.

Cieanup remedy selected.—Two major alternatives were considered: 1) leaving waste in the ground, capping the site, and treating groundwater; and 2) incineration of excavated wastes. There are three parts to the selected remedy: 1) capping the site; 2) if deemed necessary through compliance, monitoring after installation of the cover material, collecting and treating onsite the contaminated groundwater in the upper, perched water bearing zone; and s) installing fences and signs along the perimeter of the cap. "This alternative consists of site grading, cap placement, diversion of surface water, and air emissions monitoring. The site cap will be required to meet RCRA specifications. Groundwater will be treated at a later date ***if found to be necessary.*** The site will be monitored for a period of at least so years . . . to ensure that no significant contaminant concentrations migrate from the site" (emphasis added).

Estimated cost: $12 million.

Satisfaction **of SARA statutory requirements:**

1) ***Selection of permanent cleanup.—The*** ROD said that " . . . [the selected] remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable." The ROD acknowledged that capping only reduces the mobility of contaminants; groundwater treatment would also "reduce the volume and toxicity of wastes on site to some degree." Hazardous residues from water treatment would be shipped offsite to a landfill.

Full onsite thermal destruction was examined as an alternative and was given highest ratings "because this process would destroy the organic compounds in the waste." Partial onsite thermal destruction of 2 percent of the waste, coupled with capping and groundwater treatment, would have been an improvement over capping and groundwater treatment alone. Regarding full onsite thermal destruction: " . . . this remedy is not cost-effective ($339 million vs. $12 million). " However, the ROD acknowledged that full incineration would give the best overall environmental protection. Regarding partial thermal destruction: " . . . the increase in cost does not justify the negligible increase in protection to human health and the environment." Also, regarding implementability: "Onsite incineration remedies . . . will require relatively more attention during design than other remedies . . . and were therefore rated lower than the other alternatives." That is, treatment requires more work than waste containment.

2) ***Accurate assessment of land disposal and containment alternatives.*** —Regarding short-

term health effects for capping, there are" . . . essentially no risks to workers or residents." For long-term effectiveness, the remedy " . . . will successfully reduce long term risks to human health and the environment." Standard operation and maintenance for site and cap was planned. Regarding future actions: No future remedial actions are anticipated. The selected ***remedial action is considered permanent"*** (emphasis added).

The selected capping remedy, was given two higher levels of ranking for reduction of toxicity and volume of waste as compared to the no action alternative, even though capping does no more to waste than no action. Ratings for the reduction of mobility for the selected remedy are probably too high, especially because it is not certain whether or not groundwater movement would be affected.

Several other areas of uncertainty remain:

- "Future land use considerations will be evaluated in the upcoming design phase based on the needs of protection of the cap. "
- That some water infiltration through the cap, which would cause migration of contaminants into groundwater, might happen is indicated by the possible use of a synthetic liner in the cap: "The long term advantage to the liner is that less water would be generated from the seeps" (emphasis added).
- With regard to long-term impacts: "The potential for future fires and continued offsite migration of contaminants pose adverse human health and environmental impacts. ***Other impacts which the site may pose cannot be effectively predicted,*** A RCRA cap and groundwater treatment would mitigate these problems as well as most of the unseen, long term problems" (emphasis added).

In the FS for the Pristine site in Ohio, landfilling the contaminated soil was rejected "Because there is no treatment of soils to reduce the mobility, toxicity or volume [it] is ***not a permanent remedy. . .*** and [it] is the least preferred under SARA" (emphasis added). In the FS for the French Limited site (in the same EPA region as Compass), use of a slurry wall and cap to contain hazardous waste was described as a "temporary solution" for which the "volume and toxicity would not be affected" and "the potential would always exist for failure of either the cap or the slurry wall allowing for the movement of unstabilized wastes contained onsite. "

RIFS contractor. –State led, $624,000; John Mathes & Associates.

State concurrence.—"The State . . . has concurred with the capping portion of this remedy. . . . the State did not support any of the other proposed remedies."

Community acceptance.—" . . . the public was in favor of [capping] over thermal treatment of the waste. . . . the public concern was that the thermal treatment unit would create hazardous emissions and increase the potential for exposure."

Special comments:

- No treatment technology other than thermal destruction was considered in the final analysis, although other possibilities existed.
- No commitment to using a liner was made even though " . . . Subtitle C of the Resource Conservation and Recovery Act, which requires a cap with liner, is relevant and appropriate. "
- No specific technical criteria were used for deciding what types and levels of contamination found via groundwater monitoring would trigger actual groundwater treatment. There was no comment on level of certainty that groundwater monitoring would in fact detect plumes of contamination.
- No consideration was given to the effect of leaving wastes in the ground and to the effect of contaminants that have already migrated into the subsurface. These subsurface contaminants can cause future contamination of groundwater that moves into and through the site area and eventually into the Arkansas river, even though

capping reduces water infiltration through the site surface.

- Although the ROD acknowledged the SARA requirement to review the chosen remedy, which leaves waste onsite, every five years, there is no explicit commitment to doing so.

General conclusions.-The remedy selected (capping) and its supporting analysis do not satisfy statutory requirements on remedy selection. The selected remedy is not, as the ROD asserted, a permanent remedy. A number of statements in the ROD contradict the claim of permanency. For example, the possibility clearly exists for future remedial action because wastes are left untreated in the ground: "If however, future migration does occur appropriate remedial actions will be taken." The long-term uncertainties, the potential environmental risks, and future cleanup costs for capping have not been examined. Moreover, the perspective on land disposal and capping in this ROD is inconsistent with work at other Superfund sites.

EPA said that the selected remedy is less environmentally effective than thermal destruction; therefore, the chosen remedy is less cost-effective. Despite the extremely high cost of total incineration, the issue of the environmental effectiveness of capping remains. If capping is not effective, then its lower, more attractive cost does not make it cost-effective and does not make it a permanent remedy. It is not an either-or situation.

To reduce cost, the partial incineration option of hot spots of contamination could have been a compromise option. Perhaps spending two to three times more money than capping, instead of 20 to 30 times more for complete incineration, could have provided a permanent, cost-effective remedy. The ROD suggested that the site area is some 100 acres, but a statement in the responsiveness summary refers to 32 acres for the cap. In either case, the amount of soil sampling at the site—28 locations—was insufficient to accurately characterize contaminant distribution. (Assuming there are 32 acres, sampling is about one location per acre. For comparison, at the Renora site in New Jersey, sampling was done in 12 locations per acre; at the Seymour Recycling site in Indiana, it was six locations per acre; and at the Tacoma Tar Pits site in Washington, it was one-and-a-half locations per acre.) Hence, there was insufficient data to consider how partial excavation and incineration for the most contaminated areas might be cost-effective.

Doing enough soil sampling to assess a site accurately enough to detect hot spots has been studied by EPA. Soil sampling is a major effort: "Systematic sample site selection is normally used when attempting to determine areal extent of contamination or when evaluating spatial variations. Sampling locations are defined by a grid or coordinate system and samples are collected at preselected locations in a uniform pattern. " (R.J. Bruner, "A Review of Quality Control Considerations in Soil Sampling," ***Quality Control in Remedial Site Investigation,*** American Society for Testing and Materials, 1986, pp. 35-42.) The critical tradeoff between the cost of taking more or less cleanup action has been summed up by EPA: "If the cost of a false positive (incremental cleanup of additional area) is less than the cost of a false negative (health risk due to not cleaning an area), then the larger probability of false positive is acceptable. If the [contaminant concentration action level] were raised, the probability of false positives (unnecessary cleanup] would be lessened, but with an increase in the probability of a false negative (leaving a 'dirty' area)." (G.T. Flatman, "Design of Soil Sampling Programs: Statistical Considerations," ***Quality Control in Remedial Site Investigation,*** American Society for Testing and Materials, 1986, pp. 43-56.) The latter happens when average site concentrations are used to decide what cleanup to perform, because the average value is below the action level. If hot spots are found, their concentrations will be above the action level and false negative (dirty) areas, as well as false positive (clean) areas, are avoided; that is, dirty areas are cleaned, but clean areas are not.

At the Compass site, another strategy could have been to delay cleanup or to see capping as an interim remedy until more work could be done to fully examine alternative treatment