EPA United States Environmental Protection Agency

Waste Transfer Stations:

A Manual for Decision-Making

Acknowledgments

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Introduction

This manual defines what a transfer station is and how it relates to municipal solid waste management in the context of a community's total waste management plan. The manual identifies issues and factors to consider when deciding to build a transfer station, planning and designing it, selecting a site, and involving the community.

In many communities, citizens have voiced concerns about solid waste transfer stations that are poorly sited, designed, or operated. In addition, some citizens might feel that transfer stations are disproportionately concentrated in or near their communities. Yet transfer stations play an important role in a community's waste management system.

In 1993, the National Environmental Justice Advisory Council (NEJAC) was formed to "provide independent advice, consultation, and recommendations to EPA on matters related to environmental justice." The Waste and Facility Siting Subcommittee, one of NEJAC's six subcommittees, received numerous comments from citizens of several major metropolitan areas concerning the negative impacts of waste transfer stations and their disproportionate siting in low-income communities and communities of color. The Subcommittee, with support from EPA, formed the Waste Transfer Station Working Group in 1998 to investigate these comments. The Working Group arranged two fact-finding sessions in New York City and Washington, DC, during November 1998 and February 1999 respectively. These sessions were each two-day events consisting of a day of tours of area waste transfer stations and a second day of public meetings. Based upon these two fact-finding sessions, the Working Group in March 2000 published the draft report, *A Regulatory Strategy for Siting and Operating Waste Transfer Stations.* This report made several recommendations to EPA concerning proper and equitable siting and operation of transfer stations. In response in to this report, EPA has developed this manual and its companion publication *Waste Transfer Stations: Involved Citizens Make the Difference* (EPA530-K-01-003).

The intent of this manual is to promote the use of best practices in transfer station siting, design, and operation to maximize facilities' effectiveness and efficiency, while minimizing their impact on the community. It is designed to assist facility owners and operators; state, local, and tribal environmental managers; and the public evaluate and choose protective practices for siting, designing, and operation of municipal solid waste transfer stations. The manual is divided into the following chapters:

- Planning and Siting a Transfer Station
- Transfer Station Design and Operations
- Facility Oversight

What Are Waste Transfer Stations?

Waste transfer stations play an important role in a community's total waste management system, serving as the link between a commu-

Aerial view of a totally enclosed transfer station.

nity's solid waste collection program and a final waste disposal facility. While facility ownership, sizes, and services offered vary significantly among transfer stations, they all serve the same basic purpose—consolidating waste from multiple collection vehicles into larger, high-volume transfer vehicles for more economical shipment to distant disposal sites. In its simplest form, a transfer station is a facility with a designated receiving area where waste collection vehicles discharge their loads. The waste is often compacted, then loaded into larger vehicles (usually transfer trailers, but intermodal containers, railcars, and barges are also used) for long-haul shipment to a final disposal site—typically a landfill, waste-to-energy plant, or a composting facility. No long-term storage of waste occurs at a transfer station; waste is quickly consolidated and loaded into a larger vehicle and moved off site, usually in a matter of hours.

For purposes of this manual, facilities serving only as citizen drop-off stations or community convenience centers are not considered waste transfer stations. Only a facility that receives some portion of its waste directly from collection vehicles, then consolidates and reloads the waste onto larger vehicles for delivery to a final disposal facility, is considered a transfer station. A convenience center, on the other hand, is a designated area where residents manually discard waste and recyclables into dumpsters or collection containers. These containers are periodically removed or emptied, and the waste is transported to the appropriate disposal site (or possibly to a transfer station first). Convenience centers are not suitable for use as transfer stations because they cannot readily handle the large volume of waste that is discharged by a self-unloading collection truck. While these sites are not considered transfer stations within the context of this manual, it is important to note that heavily used convenience centers can face similar concerns as transfer stations (e.g., litter, road access, vehicle queuing, storm water run on and run off). Consequently, it may be appropriate to consider implementing some of the concepts and practices advocated in this manual at these sites. Many communities have installed full-service operations that provide public waste and recyclables drop-off accommodations on the same site as their transfer stations.

Source reduction and recycling also play an integral role in a community's total waste management system. These two activities can significantly reduce the weight and volume of waste materials requiring disposal, which reduces transportation, landfill, and incinerator costs. Source reduction consists of reducing waste at the source by changing product design, manufacturing processes, and purchasing and sales practices to reduce the quantity or toxicity of materials before they reach the waste stream. U.S. Environmental Protection Agency (EPA) policy promotes source reduction as the waste management technique of choice.

Recycling—the collection, processing, and manufacture of new products—likewise diverts materials from the landfill or incinerator. These recyclable materials are prepared for shipment to markets in a special facility called a MRF, which stands for materials recovery facility. A MRF is simply a special type of transfer station that separates, processes, and consolidates recyclable materials for shipment to one or more recovery facilities rather than a landfill or other disposal site. Consequently, the concepts and practices in this manual can be applied to MRFs as well.

Aggressive community source reduction and recycling programs can substantially reduce the amount of waste destined for long haul transfer and disposal. If these reductions are significant enough, a community may find that fewer or smaller transfer stations can meet its needs.

Why Are Waste Transfer Stations Needed?

The nationwide trend in solid waste disposal has been toward construction of larger, more remote, regional landfills. Economic considerations, heavily influenced by regulatory and social forces, are compelling factors leading to this result. The passage of federal criteria in 1991 established new design requirements for municipal solid waste landfills. These new standards include design, operating, and monitoring requirements that significantly add to construction, operating, closure, and post-closure monitoring costs. As older landfills near urban centers reach capacity and begin closing, cities must decide whether to construct new landfills or to seek other disposal options. Many communities find the cost of upgrading existing facilities or constructing new landfills to be prohibitively high, and opt to close existing facilities. For these communities, transferring waste to a large regional landfill is an appealing alternative.

In addition to regulatory requirements, public opposition frequently makes siting new landfills near population centers difficult. The current atmosphere is such that gaining public and political approval for constructing new disposal capacity near population centers is challenging. Also, adequate land is often not available near densely populated or urban areas. These social, political, and geographical factors have further stimulated the rise in construction of large, remote, regional landfills.

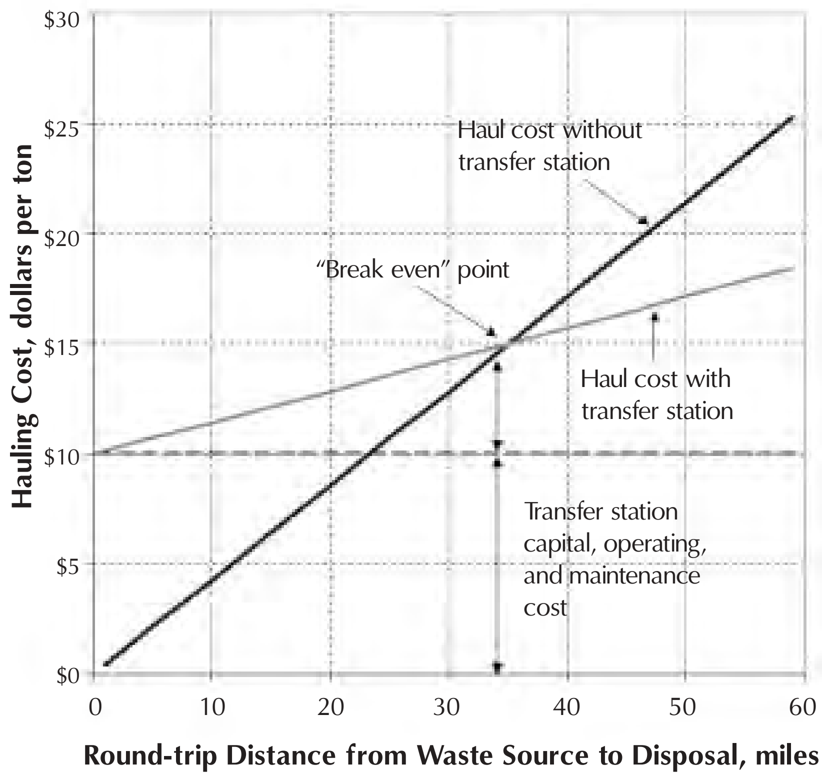
Economic considerations, especially economies of scale, further promote development of large regional facilities. To offset the high cost of constructing and maintaining a modern landfill, facility owners construct large facilities that attract high volumes of waste from a greater geographic area. By maintaining a high volume of incoming waste, landfill owners can keep the per-ton tipping fees low, which subsequently attracts more business. Rural and urban communities alike are finding that the most economically viable solution to their waste disposal needs is shipping their waste to these facilities. In these circumstances, a transfer station serves as the critical consolidation link in making cost-effective shipments to these distant facilities.

Why Use Waste Transfer Stations?

The primary reason for using a transfer station is to reduce the cost of transporting waste to disposal facilities. Consolidating smaller loads from collection vehicles into larger transfer vehicles reduces hauling costs by enabling col-

Figure 1.

Sample Comparison of Hauling Costs With and Without a Transfer Station



The following assumptions were used to create this sample comparison:

Cost to build, own, and operate transfer station—dollars per ton	$10
Average payload of collection truck hauling directly to landfill—tons	7
Average payload of transfer truck hauling from transfer station to landfill—tons	21
Average trucking cost (direct or transfer hauling)—dollars per mile	$3

The comparison shows a break-even distance of about 35 miles (round-trip). In other words, for this example, using a transfer station is cost-effective when the round-trip distance exceeds 35 miles. When the round-trip distance is less than 35 miles, direct haul is more cost-effective. Although the same economic principles apply, break-even distances will vary in different situations based on the site-specific input data.

lection crews to spend less time traveling to and from distant disposal sites and more time collecting waste. This also reduces fuel consumption and collection vehicle maintenance costs, plus produces less overall traffic, air emissions, and road wear.

In addition, a transfer station also provides:

- An opportunity to screen waste prior to disposal.

- Flexibility in selecting waste disposal options.
- An opportunity to serve as a convenience center for public use.

At many transfer stations, workers screen incoming wastes on conveyor systems, tipping floors, or in receiving pits. Waste screening has two components: separating recyclables from the waste stream and identifying any wastes that might be inappropriate for disposal (e.g., hazardous wastes or materials, white goods, whole tires, auto batteries, or infectious waste). Identifying and removing recyclables reduces the weight and volume of waste sent for final disposal and, depending on local recycling markets, might generate revenue. Screening for inappropriate wastes is more efficient at the transfer station than the landfill.

Waste transfer stations also offer more flexibility in terms of disposal options. Decision-makers have the opportunity to select the most cost-effective and/or environmentally protective disposal sites, even if they are more distant. They can consider multiple disposal facilities, secure competitive disposal fees, and choose a desired method of disposal (e.g., landfilling or incineration).

Finally, transfer stations often include convenience centers open to public use. These centers enable individual citizens to deliver waste directly to the transfer station facility for ultimate disposal. Some convenience centers offer programs to manage yard waste, bulky items, household hazardous waste, and recyclables. These multipurpose convenience centers are assets to the community because they assist in achieving recycling goals, increase the public's knowledge of proper materials management, and divert materials that would otherwise burden existing disposal capacity.

Calculating Transfer Station Break-Even Points

To calculate the break-even point for a specific facility, first determine the following values:

- **Transfer Station Cost** (cost to build, own, and operate transfer station, in dollars per ton)
- **Direct Haul Payload** (average payload of collection truck hauling directly to landfill, in tons)
- **Transfer Haul Payload** (average payload of transfer truck hauling from transfer station to landfill, in tons)
- **Trucking Cost** (average cost of direct or transfer hauling, in dollars per mile)

Once these values are known, use the following formulas to calculate cost at different distances:

Cost of Direct Haul (without the use of a waste transfer station)
Distance (miles) multiplied by Trucking Cost (dollars per mile) divided by Direct Haul Payload (tons)

Cost of Transfer Haul
Transfer Station Cost (dollars per ton) plus Distance (miles) multiplied by Trucking Cost (dollars per mile) divided by Transfer Haul Payload (tons)

Is a Transfer Station Right for Your Community?

Deciding whether a transfer station is appropriate for an individual community is based on determining if the benefits outweigh the costs. Decision-makers need to weigh the planning, siting, designing, and operating costs against the savings the transfer station might generate from reduced hauling costs. To assist in making this determination, public and private decision-makers often employ third-party solid waste experts. These experts are familiar with both the technical and regulatory issues that must be addressed in developing a successful waste transfer station. It may be helpful to retain qualified consulting or engineering firms specializing in solid waste engineering. It is also important to note that in some areas, the regulatory agency might require that the transfer station plans be certified by a professional engineer. Again, this engineer should be an experienced solid waste professional. Complex projects might also require the assistance of architects, geotechnical engineers, lawyers, and other specialists.

Although cost-effectiveness will vary, transfer stations generally become economically viable when the hauling distance to the disposal facility is greater than 15 to 20 miles.

Figure 1 demonstrates a representative "cost versus miles" relationship between direct hauling waste to disposal facilities in collection vehicles versus consolidation, transfer, and hauling in larger vehicles. Using the assumptions listed below Figure 1, we see that the average cost per ton to move the waste from the collection vehicle onto the transfer vehicle is $10 before the hauling vehicle leaves the transfer station. This is the cost per ton to build, operate, and maintain the station. Due to its economy of scale, however, the transfer trailer can move waste on a much lower "per mile" basis because it can carry the waste of several individual collection vehicles.

Using the assumptions listed, the cost per ton per mile (ton-mile) using a collection vehicle is $0.43 ($3/mile truck operating cost divided by 7 tons per average load). In this example, the transfer hauling vehicle's cost per ton-mile is much lower, at $0.14 ($3 divided by 21 tons per average load). Figure 1 shows how this cost per ton-mile advantage for the transfer hauling vehicle soon overcomes the initial cost of developing and operating the transfer station. In this case, based on the indicated assumptions, cost savings will start to be realized when the round-trip hauling distance exceeds 35 miles (17.5 miles one way). Because the cost to own, operate, and maintain collection vehicles, transfer stations, and transfer hauling vehicles will vary depending on local parameters, the break-even point indicated on Figure 1 will vary. The formulas used in generating Figure 1 are provided below to allow for site-specific calculations.

Planning and Siting a Transfer Station

A variety of issues must be taken into account during the planning and siting stages of transfer station development. This section discusses the types of waste transfer stations typically accept, factors affecting a transfer station's size and capacity, and issues regarding facility siting, including process issues and public involvement. While the planning and siting phases of facility development might involve a significant investment of resources, this initial investment is crucial to ensuring an appropriate project outcome sensitive to the host community.

Types of Waste Accepted

In addition to processing mixed municipal solid waste (MSW), some transfer stations offer programs that manage specific materials separately to divert waste from disposal and to achieve recycling objectives. These materials could include construction and demolition debris, yard waste, household hazardous waste, or recyclables. The types of materials processed often vary depending on where the facility is located (urban, suburban, rural) and who owns and operates the transfer station (public entity or private industry).

Types of waste that transfer stations commonly handle are described in the adjacent box.

If a community offers programs that manage parts of the waste stream separately, it might reduce expenses by locating the material management programs at the transfer station. Savings might result by:

- Using dual-collection vehicles for refuse and source-separated waste streams and delivering all waste to the transfer station in one vehicle.
- Continuing to use separate collections for refuse and source-separated waste streams, but having all processing facilities located at one site, thus minimizing the cost of multiple utility connections, traffic control systems, office space, and administration. This approach also eliminates the cost and complexity of multiple siting and permitting efforts.

Unacceptable Wastes

Certain wastes might be unacceptable at a transfer station for a variety of reasons, including:

- They are prohibited by state or federal regulations (e.g., PCBs, lead acid batteries, radioactive materials).

Wastes Commonly Handled at Transfer Stations

The following types of waste are commonly handled at transfer stations. Specific definitions of these wastes vary locally.

Municipal solid waste (MSW) is generated by households, businesses, institutions, and industry. MSW typically contains a wide variety of materials including discarded containers, packaging, food wastes, and paper products. MSW includes a mixture of putrescible (easily degradable) and nonputrescible (inert) materials. Three types of MSW are commonly diverted and handled separately:

> **Yard waste (green waste)** commonly includes leaves, grass clippings, tree trimmings, and brush. Yard waste is often diverted so that it may be composted or mulched instead of going for disposal.
>
> **Household hazardous waste (HHW)** includes hazardous materials generated by households, such as cleaning products; pesticides; herbicides; used automotive products such as motor oil, brake fluid, and antifreeze; and paint.
>
> **Recyclables** include discarded materials that can be reprocessed for manufacture into new products. Common recyclables include paper, newsprint, ferrous metals, plastic, glass containers, aluminum cans, motor oil, and tires.

Construction and demolition (C&D) debris results from demolition or construction of buildings, roads, and other structures. It typically consists of concrete, brick, wood, masonry, roofing materials, sheetrock, plaster, metals, and tree stumps. Sometimes C&D debris is managed separately from MSW; other times it is mixed with MSW.

- They are difficult or costly to process (e.g., tires).
- They might pose a health or fire hazard.
- They might be prohibited at the disposal facility to which the transfer station delivers.
- They might be prohibited (within a mixed waste load destined for disposal) because local regulations require they be recycled.
- They might be so large that they could damage trucks or equipment during waste loading operations.

The following types of wastes are typically not accepted at transfer stations: large bulky objects such as tree stumps, mattresses, or furniture; infectious medical waste; hazardous waste; explosives; radioactive materials; fuel tanks (even if empty); appliances; dead animals; asbestos; liquids and sludges; and dust-prone materials. This is a general list; some transfer stations might be set up to process these wastes, while others might have a longer list of unacceptable materials. While these and other unacceptable wastes represent a small fraction of the solid waste stream, properly managing them can require significant effort by the transfer station operator and the local solid waste management authority. The section on waste screening in the Transfer Station Design and Operation chapter further discusses how to properly manage and reduce the frequency of unacceptable waste at a transfer station.

Public Versus Commercial Use

Some transfer stations provide public access to the facility rather than restricting access only to waste collection vehicles. The types of customers accommodated vary depending on where the facility is located and who owns and operates the transfer station. Publicly operated transfer stations are more likely to be open to public use. Private transfer stations might not be open to the public because residents deliver relatively small amounts of waste with each visit, require more direction for safe and efficient use of the transfer station, and generally pay relatively small fees for using the transfer station. The general public usually is allowed to use a transfer station for any of several reasons: waste collection is not universally provided in the area; some wastes, such as bulky items or remodeling debris, are not collected; or public access is part of a strategy to prevent illegal dumping by providing a convenient, cost-effective place for people to deposit waste. Public unloading areas and traffic patterns are usually kept separate from commercial vehicles for safety and efficiency.

Determining Transfer Station Size and Capacity

The physical size of a planned transfer station is typically determined based on the following factors:

- The definition of the service area. Sometimes this is relatively simple, such as "all waste generated by Anytown, USA," or "all waste collected by Acme Hauling Company." Other times, the service area is more difficult to define because of varying public and private roles in solid waste management and the changing availability of existing disposal facilities.
- The amount of waste generated within the service area, including projected changes such as population growth and recycling programs.
- The types of vehicles delivering waste (such as car or pickup truck versus a specially designed waste-hauling truck used by a waste collection company).
- The types of materials to be transferred (e.g., compacted versus loose MSW, yard waste, C&D), including seasonal variations.
- Daily and hourly arrival patterns of customers delivering waste. Hourly arrivals tend to cluster in the middle of the day, with typical peaks just before and after lunchtime. Peak hourly arrivals tend to dictate a facility's design more than average daily arrivals.
- The availability of transfer trailers, intermodal containers, barges, or railcars, and how fast these can be loaded.

- Expected increases in tonnage delivered during the life of the facility. For example, in a region with annual population growth of 3 to 4 percent, a facility anticipating a 20-year operating life would typically be designed for about twice the capacity that it uses in its first year of operation.
- The relationship to other existing and proposed solid waste management facilities such as landfills, recycling facilities, and waste-to-energy facilities.

The same factors are used to determine the size of the following transfer station features:

- Amount of off-street vehicle queuing (waiting) space. At peak times, vehicles must often wait to check in at a facility's "gatehouse" or "scale house." It is important that the queue (line) not block public streets or impede vehicular or pedestrian traffic.
- Number and size of unloading stalls, and corresponding number of transfer trailer loading positions.
- Short-term waste processing and storage areas (for holding waste until it can be reloaded into transfer vehicles).

Present and projected daily, weekly, and annual waste volumes (including seasonal variations) are important in planning facility size to accommodate waste deliveries. The maximum rate at which waste is delivered is a crucial consideration as well. In general, it is best to build a facility to accommodate present and projected maximum volumes and peak flows, with a preplanned footprint for facility expansion. A useful exercise is calculating how much tipping floor space a facility would require to store a full day's waste in case of extreme emergency. One approach to estimating the required tipping floor space is to begin with a base area of 4,000 square feet and add to it 20 square feet for each ton of waste received in a day (assuming the waste will be temporarily piled 6 feet high on the tipping floor).[1] For example, if the facility receives 100 tons of waste per day, a tipping floor space of 6,000 square feet would be required (i.e., 4,000 ft^2 + (100 TPD x 20 ft^2/ton) = 6,000 ft^2) "Chapter 4: Collection and Transfer" in EPA's *Decision Maker's Guide to Solid Waste Management* also provides a series of formulas for helping determine transfer station capacity These formulas are presented in the box below.

Formulas for Determining Transfer Station Capacity

Stations with Surge Pits

Based on rate at which wastes can be unloaded from collection vehicles:

$$C = P_C \times (L / W) \times (60 \times H_W / T_C) \times F$$

Based on rate at which transfer trailers are loaded:

$$C = (P_t \times N \times 60 \times H_t) / (T_t + B)$$

Direct Dump Stations

$$C = N_n \times P_t \times F \times 60 \times H_W \ / [(P_t/P_c) \times (W/L_n) \times T_c] + B$$

Hopper Compaction Stations

$$C = (N_n \times P_t \times F \times 60 \times H_W) / (P_t/P_c \times T_c) + B$$

Push Pit Compaction Stations

$$C = (N_p \times P_t \times F \times 60 \times H_W) / [(P_t/P_c) \times (W/L_p) \times T_c] + B_c + B$$

Where:

C	Station capacity (tons/day)
P_C	Collection vehicle payloads (tons)
L	Total length of dumping space (feet)
W	Width of each dumping space (feet)
H_W	Hours per day that waste is delivered
T_C	Time to unload each collection vehicle (minutes)
F	Peaking factor (ratio of number of collection vehicles received during an average 30-minute period to the number received during a peak 30-minute period)
P_t	Transfer trailer payload (tons)
N	Number of transfer trailers loading simultaneously
H_t	Hours per day used to load trailers (empty trailers must be available)
B	Time to remove and replace each loaded trailer (minutes)
T_t	Time to load each transfer trailer (minutes)
N_n	Number of hoppers
L_n	Length of each hopper
L_p	Length of each push pit (feet)
N_p	Number of push pits
B_c	Total cycle time for clearing each push pit and compacting waste into trailer

Source: Decision-Makers Guide to Solid Waste Management, Secon Edition (EPA530-R-95-023), p. 4-23.

1 Solid Waste Association of North America. 2001. *Transfer Systems Management Training Course*. SWANA. Washington, DC.

Queuing in Urban Areas

In extreme situations where adequate queuing space cannot be provided on the transfer station site, an additional offsite area can be provided as a holding area for waiting trucks. Transfer station staff can dispatch the waiting trucks via radio when the station is ready to receive them.

Number and Sizing of Transfer Stations

Design capacity is determined by the maximum distance from which waste can be economically delivered to the transfer station. The area that can efficiently reach the waste transfer station determines the volume of waste that must be managed, which is the facility's initial design capacity. Beyond a certain distance, another transfer station might be necessary, or it might become just as cost-effective to direct haul to the disposal facility.

Transfer stations serving rural or tribal areas tend to be small. They are optimally located within a reasonable driving time from the service area's largest concentration of homes and businesses. For example, a rural transfer station could be located near one of the service area's larger towns and sized to take waste from all waste generators within about 30 miles. As an example, two 50-ton-per-day transfer stations might each serve six small communities. Alternately, fewer transfer stations could be used, necessitating longer average travel distances. For example, one 100-ton-per-day transfer station could be used to serve the same 12 small communities, but it would be located farther from the outlying communities.

In urban or suburban areas, the same situations exist. A midsize city (population 500,000), for example, might decide that two 800-ton-per-day transfer stations would best serve its community. This same city could alternately decide that a single 1,600-ton-per-day transfer station is its best option, even when the longer driving distances are considered. When deciding which approach is best for a community, issues to consider include the impacts the transfer station(s) will have on the surrounding area, siting complications, and the cost to build and operate the transfer station(s). Each approach offers advantages and disadvantages that must be reconciled with local needs.

Addressing Site Size Limitations

When site size is not adequate to accommodate ideal designs and practices, additional engineering design features will be needed to mitigate the facility's potential negative impacts. For example, sound barriers might need to be incorporated into the site plan to reduce noise. Another approach is to select multiple, smaller capacity sites if a single parcel of land large enough to accommodate an ideal facility does not exist. These separate sites could be used to hold trucks awaiting delivery, or to store transfer trailers.

The biggest advantage of constructing large transfer stations is the economies of scale that can significantly reduce capital and operational costs. Centralizing waste transfer operations allows communities to reduce equipment, construction, waste handling, and transportation costs. The siting of a single facility may often prove easier than siting multiple facilities. Large facilities are also conducive to barge or rail operations that can further decrease traffic-related impacts on the community. Along related lines, however, a major drawback to building a single large facility is locating a tract of land that adequately meets facility requirements. Large facilities also tend to concentrate impacts to a single area, which can create the perception of inequity, especially when one neighborhood is shouldering the burden for the entire city. A single facility can result in longer travel times, which leads to increased down time for the collection crew and increased wear and tear on collection vehicles. Another consideration is that a single facility cannot divert waste to a backup facility if a need arises. The single facility must have additional equipment in case of equipment failure or other emergencies.

In other situations, multiple smaller sites might better address a community's waste management needs. Decentralizing waste transfer operations spreads lesser impacts over a wider area, which helps address equity issues. Although it is generally more expensive to build and operate several small transfer stations rather than one large station with the same total capacity, savings from reduced travel times might offset these capital costs and result in lower overall system costs. Multiple facilities also are better able to serve as backups for one another in case of scheduled or emergency shutdowns of facilities. The major disadvantage to building multiple facilities is that the difficulties encountered in siting a single facility can become multiplied.

Future Expansion

Transfer stations are frequently designed to accommodate future expansion. Often, this is accomplished by siting the facility on a larger parcel of land than would otherwise be necessary and preplanning the site and buildings so expansion can occur without negatively affecting other functions on the site or the surrounding community. Although expansion of effective capacity can sometimes be accomplished simply by expanding the hours of operation, this approach is not always effective because the transfer station must accommodate the collection schedules of vehicles delivering waste to the facility. In addition, increased operating hours might not be compatible with the surrounding community.

Site Selection

Identifying a suitable site for a waste transfer station can be a challenging process. Site suitability depends on numerous technical, environmental, economic, social, and political criteria. When selecting a site, a balance needs to be achieved among the multiple criteria that might have competing objectives. For example, a site large enough to accommodate all required functions and possibly future expansion, might not be centrally located in the area where waste is generated. Likewise, in densely developed urban areas, ideal sites that include effective natural buffers simply might not be available. Less than ideal sites may still present the best option due to transportation, environmental, and economic considerations. Yet another set of issues that must be addressed relates to public concern or opposition, particularly from people living or working near the proposed site. The relative weight given to each criteria used in selecting a suitable site will vary by the community's needs and concerns. Whether the site is in an urban, suburban, or rural setting will also play a role in final site selection.

Environmental Justice Considerations

During the site selection process, steps should be taken to ensure that siting decisions are not imposing a disproportionate burden upon low-income or minority communities. Overburdening a community with negative impact facilities can create health, environmental, and quality of living concerns. It can also have a negative economic impact by lowering property values and hindering community revitalization plans. These are just a few of the reasons environmental justice concerns need to be addressed when selecting a site for a waste transfer station.

The Siting Process and Public Involvement

A siting process that includes continuous public participation is integral to developing a transfer station. The public must be a legitimate partner in the facility siting process to integrate community needs and concerns and to influence the decision-making process. Addressing public concerns is also essential to building integrity and instituting good communications with the community. Establishing credibility and trust with the public is as

Maximizing Public Committee Participation

Public committees are often convened to assist with developing public policy. To maximize participation, the process should:

- Give committee members a chance to be actively involved.
- Allow the committee to remove the selected facilitator if concerns about objectivity exist.
- Encourage members to discuss relevant concerns and to raise questions or objections freely. Criticisms or challenges should be directed toward the issues; the facilitator should swiftly mitigate personal criticisms.
- Agree on a means to resolve disagreements before they arise.
- Allow members to discuss the results of each meeting with their constituents.
- Provide technical experts to educate participants.
- Distribute literature about upcoming issues before meetings.

Informing the Community

When initiating a siting process, education must be extended beyond the siting committee and include a communitywide outreach initiative. Components of this type of public outreach typically include:

- Special public meetings.
- Interviews with local newspapers for feature stories.
- Interviews with media editorial boards.
- Interviews with broadcast media.
- News conferences, press releases, and press kits.
- Paid advertising.
- Internet sites.
- Informational literature.
- Direct mail with project updates.
- City council/county commission presentations.
- Presentations to civic, environmental, religious, and professional groups.
- Presentations to neighborhood groups.
- Community education programs and workshops.
- Reading files located in public libraries or community centers that document the process.

Beyond communitywide outreach, initiate specific and targeted contact with key members of potential host communities, and identify community-specific conditions that need to be considered. Individuals might become proponents of the proposed facility if contacted directly for input, rather than opposing it based on misleading secondhand information.

important as addressing environmental, social, and economic concerns about the solid waste facility.[2] A companion document to this manual, *Waste Transfer Stations: Involved Citizens Make the Difference* (EPA530-K-01-003), provides key information citizens require to be effectively involved in the siting and development process. Two other EPA documents, *Sites for Our Solid Waste: A Guidebook for Effective Public Involvement* (EPA 530-SW-90-019) and *RCRA Public Participation Manual* (EPA530-R-96-007), provide further information and examples of how to integrate public participation into the waste management facility siting and development process. Following are some general guidelines for developing and implementing a siting process that is open to and integrates meaningful public input.

For publicly developed transfer stations, a good first step by public officials in the site selection process is establishing a siting committee. The committee's main responsibility includes developing criteria to identify and evaluate potential sites. The committee should consist of key individuals who represent various stakeholder interests. These stakeholders might include:

- Community and neighborhood groups.
- Industry and business representatives.
- Civic and public interest groups.
- Environmental organizations.
- Local- and state-elected officials.
- Public officials, such as public works employees and solid waste professionals.
- Academic institutions.

Committee members should be selected to ensure broad geographical representation from across the area to be served by the transfer station. In addition, committee representation should seek gender balance and racial diversity. Volunteer participation should also be solicited.

The committee's meeting times and dates must be planned and scheduled to facilitate attendance by all committee members and other members of the public. Therefore, meeting schedules should avoid conflicts with other major community, cultural, or religious events. To encourage active public participation, meetings should be prominently advertised in the media in a timely manner and be held in facilities accessible to the disabled and located on public transportation routes. Frequently, a facilitator is hired or appointed to keep the meetings focused, to minimize the

2 McMaster Institute of Environment and Health, "Psychological Impacts of the Landfill Siting Process in Two Southern Ontario Communities."

Building Reuse: Weighing the Consequences

Adapting an existing building for reuse as a waste transfer station is usually done as a capital cost savings measure. Building reuse saves on new site construction and can avoid the permitting process if the existing site already has a permit allowing the waste transfer activity. Building reuse can have some benefits, including conserving construction materials required for new structures and facilities; reducing waste from the demolition of existing buildings; recycling unused property for which no other uses were found; and redeveloping contaminated property (brownfields redevelopment). But the negative aspects frequently outweigh the positives.

Pitfalls and problems associated with adaptation or retrofitting of buildings for waste transfer stations include:

- Transfer buildings have unique requirements rarely found in structures designed for other uses. These include the need for vertical clearances sufficient to accommodate the tipping height of commercial collection vehicles. New facilities are usually designed with at least 25 to 30 feet of vertical clearance from the tipping floor to the lowest overhead element.
- Busy transfer stations require adequate onsite space for vehicle parking and queuing, something reused buildings often lack. In fact, one of the most common problems with building reuse is inadequate queuing space, which leads to vehicles blocking neighborhood streets. Queuing trucks on city streets creates health and safety issues, and can be very disruptive for the surrounding neighborhood.
- Transfer stations need relatively large, open floor areas suitable for maneuvering large vehicles. Interior building columns and walls might not accommodate the kind of safe traffic movements that are needed, which could pose a hazard and reduce traffic efficiency.
- Enclosed transfer structures also require large, very tall access doors. Doors 24-feet high are not unusual in new transfer buildings. The design must assume that a collection truck will inadvertently exit the transfer station building with its tipping bed extended.
- Heavy-duty, skid-resistant floors are a necessity in transfer stations. Sloped floors with positive drainage are also important. Some buildings are not designed with floors that meet these essential criteria, and replacing the floors can be costly.
- Older structures, particularly older warehouse type structures, often fail to meet current structural design codes. In particular, modern seismic and fire code requirements have changed considerably in recent years. Retrofitting older structures might prove more costly than demolishing and replacing the structure.
- Transfer station structures can experience substantial vibrations from heavy equipment used to compact and load waste into the transfer vehicles. Concrete and steel floors, pillars, and other building reinforcements must be designed to accommodate these high levels of vibration. Older buildings not designed for this heavy use often can not meet these requirements.
- Most transfer stations require some amount of grade separation so waste can be loaded into open-topped vehicles to simplify the waste loading process. Since customer and transfer vehicles both need to access the structure, but at different levels, finding a building that offers this configuration might prove difficult. Installing additional levels or tunnels can be costly or impractical in some areas (i.e., shallow ground water or bedrock).
- Waste transfer stations include more than just the tipping area. While an existing building might be very adaptive to waste transfer, the overall building site needs to accommodate the supporting activities and requirements including traffic queuing, buffer zones, scale facility operations, etc.

Transfer station structures require tall access doors to accomodate collection vehicles.

Community Involvement in Privately Developed Facilities

In the past, privately developed facilities have not generally formed siting committees. When private facilities have been sited, the public's first—and sometimes only—opportunity for input has come when the permit application is put out for public comment. Most states do not require private developers to seek public involvement in the site selection or facility design and operation decisions. Private companies, however, should consider establishing siting committees and developing public outreach programs to establish credibility, build public trust, and develop sound avenues of communication. These programs should educate the community about the need for the facility, the facility's design and operations, and provide an opportunity for community input. A public outreach program helps the developer understand community concerns and address them early in the siting and design phases while changes are still readily incorporated. Adopting, with appropriate modifications, the public involvement process outlined above is one approach to addressing community concerns.

potential for certain individuals or interest groups to dominate the process, and to encourage active participation by all stakeholders throughout the process.

During the siting committee's first meeting, individual duties, group responsibilities, and process issues need to be addressed. Expectations and limitations of the committee need to be clearly communicated and might be summarized in mission statements. Rules for discourse, and a schedule and procedures for final decision-making, should be determined and agreed upon. Technical experts should be involved early in the process to respond to general questions and to resolve common misconceptions about waste transfer.

After establishing general procedures, committee members should be informed of all details to further ensure equal participation and a means of influencing the decision-making process. Committee members should understand why a transfer station is needed and the facility's role within the solid waste management system. In addition, committee members must be taught the numerous technical, environmental, and economic aspects associated with siting, designing, and operating a transfer station. This ensures that the siting criteria the committee develops will result in identifying potential sites feasible from engineering and operational perspectives, as well as acceptable to the public.

Educational materials for the siting committee should provide useful, objective information. Mistrust of technical information might develop among the committee members and should be anticipated. The credibility of the technical information might be enhanced by encouraging the committee to assist in selecting consultants and technical experts, by encouraging committee members to perform their own research, by using a third party to review technical studies, and by relying on experts who reside within the community to provide technical information. Information should be relayed in various formats and should consider language barriers, literacy levels, and preferred types of communications. For example, committee education might include presentations by technical experts and tours of existing transfer stations in addition to written materials.

Siting Criteria

Once the committee completes the education phase, criteria should be developed for identifying and evaluating potential sites. All siting criteria must be developed before identifying potential transfer station sites. This approach ensures siting decisions are based on objective criteria. Three categories or sets of criteria applied during various stages of the siting process are exclusionary, technical, and community-specific criteria. It is important to note that no site may meet all the criteria, in which case, each criterion's relative weight and importance must be considered.

Exclusionary Siting Criteria

Siting a waste transfer station, or any type of facility, in areas with preclusive siting criteria is often prohibited by federal, state, or local laws or regulations, or requires facilities to incorporate special engineering design and construction techniques. Even when siting in excluded zones is allowed, the added engineering designs or strong public opposition can significantly increase construction costs. In general, it is best to avoid siting in these areas. Exclusionary criteria might include areas such as:

- Wetlands and floodplains.
- Endangered and protected flora and fauna habitats.
- Protected sites of historical, archeological, or cultural significance.
- Prime agricultural land.
- Parks and preserves.

Some examples of federal laws defining these areas include the Endangered Species Act; the Migratory Bird Conservation Act; the Coastal Zone Management Act; the Wild and Scenic Rivers Act; the Marine Protection, Research, and Sanctuaries Act; and the National Historic Preservation Act.

Technical Siting Criteria

The second category of criteria to develop includes technical parameters that help define the best potential facility sites. These criteria provide guidance on specific engineering, operation, and transportation conditions that should be considered to ensure that potential sites are feasible from technical, environmental, and economic perspectives. These criteria address the following issues:

- **Central location to collection routes:** To maximize waste collection efficiency, transfer stations should be located centrally to waste collection routes. As a rule of thumb in urban and suburban areas, transfer stations should be no more than 10 miles away from the end of all collection routes. Beyond that distance, collection routes might need to be altered to enable refuse to be collected and deposited at the transfer station within one operating shift.
- **Access to major transportation routes:** The transfer station should have direct and convenient access to truck routes, major arterials, and highways (or rail or barge access, if appropriate). For large metropolitan areas, direct access to rail lines or barges will significantly reduce the number of large transfer trailers leaving the station and traveling area roads. It is preferable to avoid routing traffic through residential areas because traffic generated by transfer stations contributes to congestion; increased risk to pedestrians; increased air emissions, noise, and

Addressing Cluster Zoning

Siting waste transfer stations exclusively in areas zoned for industrial use can lead to a condition known as "cluster zoning." Especially restrictive zoning frequently forces transfer stations into a few areas. In general, siting transfer stations in industrial zones eliminates permitting agencies' discretion to deny such use because technically, the transfer station is permitted "as a matter of right." These types of zoning actions also prevent an impacted community from influencing the zoning decision. Such intensive clustering of industrial facilities may have negative impacts on neighboring residents, such as increased traffic, noise, odors, and litter. Communities need to address clustering and zoning issues at the local level through comprehensive planning that considers the aggregate effects of clustering certain activities and the equity in sharing community burdens. To avoid clustering when siting a new waste transfer station, establish a community stakeholder or advisory panel to participate in the siting process. This advisory panel should consist of representatives from all potentially affected communities; state, local, and/or tribal regulatory agencies; public and private waste trade groups; local community development organizations; and any other concerned community, environmental, or environmental justice organizations.

To prevent disproportionate facility siting:

- Zoning must not be presumed to prevent significant impacts on poor and minority communities.
- The potential for clustering should be examined.
- Other close or adjacent land uses should be examined to determine compatibility.
- Other close or adjacent land uses should be examined to analyze cumulative impacts.

Requiring Minimum Distance Between Transfer Stations

Communities with a waste transfer station clustering problem might consider requiring a minimum distance between facilities as one possible solution. Designating a minimum distance between waste transfer stations, or other industrial facilities, will limit clustering by forcing the siting of new facilities away from existing operations. The end effect can be a more equitable dispersion of facilities and their negative impacts. A community will need to determine what minimum distance is reasonable.

wear on roads; and might contribute to litter problems.

- **Site size requirements:** The area required for specific transfer stations varies significantly, depending on the volume of waste to be transferred, rates at which waste will be delivered, the functions to be carried out at the site, and the types of customers the facility is intended to serve. Locating a site of sufficient size is critical to operating efficiencies and minimizing impacts on the surrounding community. Engineering input can establish preliminary size criteria based on a conceptual design.

- **Sufficient space for onsite roadways, queuing, and parking:** Transfer stations typically have onsite roadways to move vehicles around various parts of the transfer site. Waste collection trucks can be up to 40 feet long. Transfer trailers that move waste to a disposal facility are typically 50 to 70 feet long. These vehicles need wide roadways with gradual slopes and curves to maneuver efficiently and safely. Also, the site will need space for parking transfer vehicles and to allow incoming and outgoing traffic to form lines without backing up onto public roads.

- **Truck and traffic compatibility:** Transfer stations often receive surges of traffic when collection vehicles have finished their routes. Transfer station traffic varies locally, but tends to peak twice a day. The first peak is often near the middle of the day or shift, and the second at the end of the day or shift. Therefore, the best sites for transfer stations are located away from areas that have midday traffic peaks and/or school bus and pedestrian traffic.

Many transfer stations are multi-level facilities that allow vehicle access at several levels.

- **Ability for expansion:** When selecting a site, consider the potential for subsequent increase in the daily tonnage of waste the facility will be required to manage, or added processing capabilities for recycling and diversion. It is frequently less expensive to expand an existing transfer station than to develop a new site due to the ability to use existing operations staff, utility connections, traffic control systems, office space, and buildings.

- **Space for recycling, composting, and public education:** A transfer station could be sited in areas also conducive to recycling or composting activities. Many transfer stations are designed to enable residents and businesses to drop off recyclables and yard waste in addition to trash. Some transfer stations incorporate education centers or interpretive trails focusing on waste prevention. These types of facilities offer increased utility to the community.

- **Buffer space:** To mitigate impact on the surrounding community, a transfer station should be located in an area that provides separation from sensitive adjoining land uses such as residences. Buffers can be natural or constructed and can take many forms, including open spaces, fences, sound walls, trees, berms, and landscaping.

- **Gently sloping topography:** Transfer stations often are multilevel buildings that need to have vehicle access at several levels. Completely flat sites need ramps or bridges constructed to allow vehicle access to upper levels (or areas excavated to allow access to lower levels). Sites with moderately sloping terrain can use topography to their advantage, allowing access to the upper levels from the higher parts of the natural terrain and access to lower levels from the lower parts. Sites with steep slopes might require extra costs associated with earthmoving and retaining walls.

- **Access to utilities:** Transfer stations generally require electricity to operate equipment, such as balers and compactors; lighting; water for facility cleaning, restrooms, and drinking; and sanitary sewer systems for waste-water disposal. Some smaller transfer stations use wells for water supply, and some, especially in more rural settings, use septic systems or truck their waste water for offsite treatment.
- **Zoning Designations and Requirements:** Zoning ordinances frequently classify transfer stations as industrial uses, which limits their siting to areas zoned for industry usually in conjunction with a special use permit. Exclusive use of predetermined land use criteria, however, might result in locating transfer stations in areas already overburdened with industries or clustering of these types of facilities in areas adjacent to poor and minority communities. If local zoning ordinances are so restrictive that they disallow facility siting outside pre-established industrial zones, substantial engineering and architectural design must be incorporated into the facility to minimize impacts on the surrounding community.

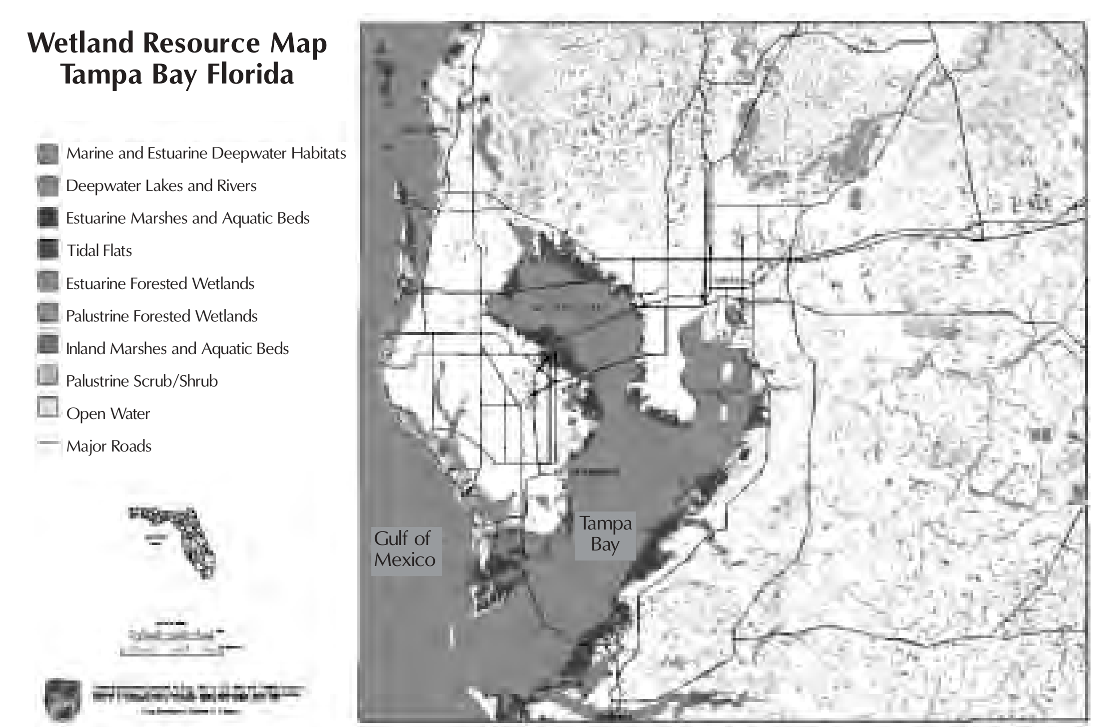
Developing Community-Specific Criteria

The third category of criteria to consider are impacts that the facility will have on the surrounding community. These criteria are typically less technical in nature and incorporate local, social, and cultural factors. Examples of these criteria include:

- Environmental Justice considerations (e.g., clustering, cumulative impacts).
- Impact on air quality.
- Impact on the local infrastructure.
- Adjacent land uses, including other environmental stressors that might already exist.
- Proximity to schools, churches, recreation sites, and residences.

Using GIS to Narrow the Search

A geographic information system (GIS) is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information (data identified according to location). After the data are entered, each positive attribute or exclusionary criteria for siting transfer stations can be layered on top of municipal maps, as well as each other, to narrow down potential site locations. The maps show these variables in relationship to infrastructure and housing patterns.



- Prevailing winds.
- Number of residences impacted.
- Presence of natural buffers.
- Impacts on existing businesses.
- Expansion capability.
- Buffer zones and screening measures.
- Traffic compatibility.
- Impact on historic or cultural features.
- Impact on neighborhood character.

To maintain objectivity in the facility siting process, the community-specific criteria should be prioritized before potential sites are known. After potential sites are identified, the committee will apply these criteria to evaluate each potential site's suitability as a waste transfer station. These issues also factor into permitting decisions concerning private facilities and should not be ignored by the permitting agency or transfer station developer.

Applying the Committee's Criteria

After all three categories of siting criteria are agreed upon, it is time for the committee to apply the criteria and narrow down all possible sites. Keep in mind, however, that despite the best efforts, every site has some shortcomings that will need to be addressed.

First, the exclusionary criteria can be plotted on maps, which helps the committee visualize where the facility cannot be sited due to local, state, and federal regulations. Once unsuitable areas are eliminated, the committee's technical criteria and community-specific criteria are applied to all remaining options. Information for each potential site should be developed so the committee can rank the sites. Based on the committee's ranking, the top two to four sites should undergo more rigorous analysis to determine technical feasibility and compliance with the environmental and community objectives.

Host Community Agreements

Siting any type of solid waste management facility has often been met with strong community opposition. Whether the facility is publicly or privately owned, many residents may not be confident that the siting, permitting, and oversight process will be sufficiently rigorous to address their concerns and protect them from future impacts. When this type of opposition arises, it is often advantageous for the developer to enter into a separate agreement with the surrounding community, laying out all issues of concern and the developer's action plan in response. These "host community agreements" are most frequently used when private companies are developing a facility, but public agencies might also find them useful in satisfying community concerns. These agreements typically specify design requirements, operating restrictions, oversight provisions, and other services and benefits that the immediate community will receive. Provisions might include the following:

- Steps to reduce negative environmental impacts in the immediate area, such as committing to the use of low emission or alternative fueled vehicles, or retrofitting vehicles with particulate filters.
- Limitations on waste generation sources.
- Roadside cleanup of litter on access routes.
- Restrictions on facility operating hours.
- Restrictions on vehicle traffic routes.
- Financial support for regulatory agencies to assist with facility oversight.
- Independent third-party inspection of facilities, or the use of video monitoring.
- Assistance with recycling and waste diversion objectives.
- A fee paid to the local government for every ton of waste received at the facility.
- Free or reduced-cost use of the facility for the community's residents and businesses.
- Guaranteed preference to the community's residents for employment.

- Funding for road or utility improvements.
- Provisions for an environmental education center.
- Financial support for other community based activities.

These agreements can also require that community representatives have access to the facility during operating hours to monitor performance. Safety concerns must be addressed if this provision is included. Community representatives usually welcome an ongoing communication process between facility operators and an established citizen's committee to encourage proactive response to evolving issues. The provisions or amenities in a host community agreement generally are in addition to what state and local standards or regulations require, and thus should not be thought of as substitutes for adequate facility design and operation. The same is true for state, tribal or local government compliance enforcement. The government agency responsible for transfer station compliance also should make a commitment to the community concerning its role in actively and effectively enforcing all requirements.

Transfer Station Design and Operation

This section discusses the many factors that affect a transfer station design. The general design issues discussed in this section can typically be applied at a variety of facility sites and over a wide range of facility sizes. Specific design decisions and their costs, however, can only be finalized once a specific site is selected. After determining who will use the facility and how, a site design plan can be developed. A facility's design must accommodate its customers' vehicles and the technology used to consolidate and transfer waste, provide for employee and public safety, and address environmental concerns related to safeguarding health and being a good neighbor to the surrounding community.

Transfer Station Design

How Will the Transfer Station Be Used?

The most important factors to consider when designing a transfer station are:

- Will the transfer station receive waste from the general public or limit access to collection vehicles? If access will not be limited, how will citizen traffic be separated from commercial traffic to ensure safe and efficient unloading?
- What types of waste will the transfer station accept?
- What additional functions will be carried out at the transfer station (i.e., material recovery programs, vehicle maintenance)?
- What type of transfer technology will be used?
- How will waste be shipped? Truck, rail, or barge?
- What volume of material will the transfer station manage?
- How much waste will the facility be designed to receive during peak flows?
- How will climate and weather affect facility operations?

Two other factors to consider when developing a transfer station's design include:

- How will environmental impacts to the surrounding area be minimized? (Ways to minimize environmental impacts on the community are discussed in the Environmental Issues section beginning on page 33.)
- How will employee health and safety be ensured? (The Safety Issues section beginning on page 40 discusses several design features, technologies, and operational practices to help protect the health and safety protection of facility employees.)

Site Design Plan

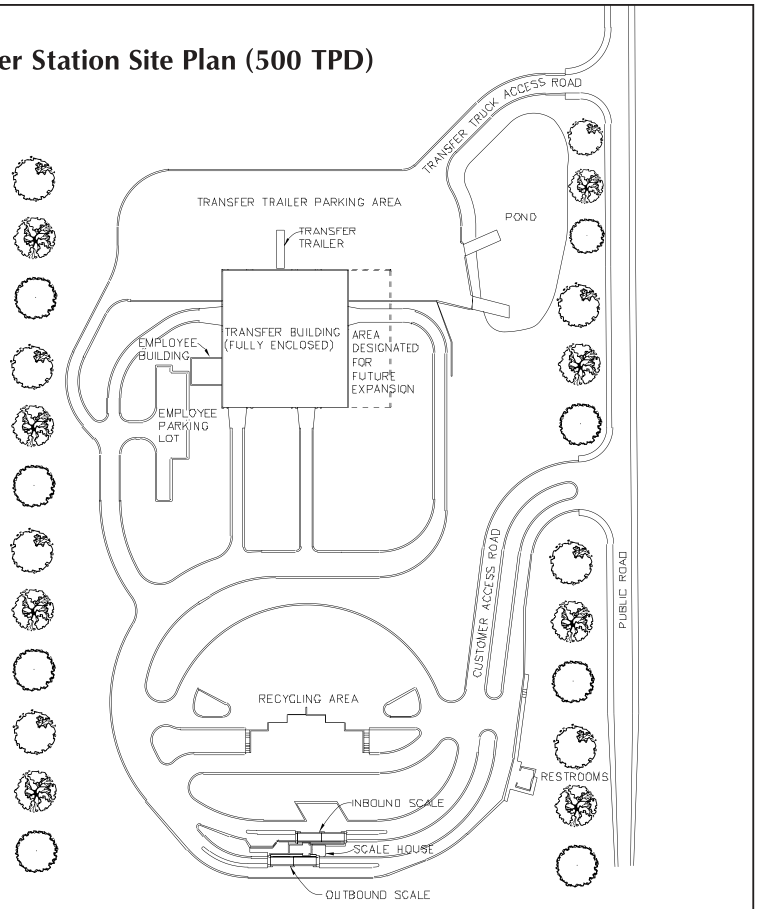
Once a site is identified for the transfer station, planners, architects, and engineers use the factors described above to develop a site plan for the proposed facility.[2] A site plan shows the layout of the transfer station site's major features, including access points, roadways, buildings, parking lots, utilities, surface-water drainage features, fences, adjacent land uses, and landscaping.

Figure 2 shows a simplified example of a site design plan of a fully enclosed transfer station. This facility has a design capacity of 500 tons per day and occupies a 25-acre site. It serves both the general public and waste collection vehicles and has a citizen drop-off area for recyclables.

Site design plans typically show the following features:

2 Sometimes a "conceptual site plan" is developed before a site is identified. This can be helpful in identifying and assessing the size and suitability of candidate sites.

Figure 2
Transfer Station Site Plan (500 TPD)



- **Road entrances and exits.** Including acceleration/deceleration lanes on public streets, and access points for waste arriving and departing from the transfer station. Some facilities have separate access for visitors and employees so these vehicles do not have to compete with lines of vehicles using the facility.
- **Traffic flow routes on site.** Often, separate routes are established for public use and for heavy truck use. Designers work to eliminate sharp turns, intersections, and steep ramps.
- **Queuing areas.** Queues can develop at the inbound scales, the tipping area, and the outbound scales. Queuing space should be clearly identified, and queues should not extend across intersections.
- **The scale house.** Incoming and outgoing loads are weighed and fees are collected.
- **Primary functions at the transfer station building.** Including tipping floor, tunnels, ramps, etc.
- **Buildings.** Including entrances and exits for vehicles and people.
- **Parking areas.** Employees, visitors, and transfer vehicles.
- **Public conveniences.** Such as separate tipping areas for the general public, recycling dropoff areas, a public education center, and restrooms.
- **Space for future expansion of the main transfer building.** Often, this area is shown as a dotted line adjacent to the initial building location.
- **Buffer areas.** Open space, landscaping, trees, berms, and walls that reduce impacts on the community.
- **Holding area.** For inspecting incoming loads and holding inappropriate waste loads or materials for removal.

Main Transfer Area Design

Most activity at a transfer station occurs within the main transfer building. Here, cars and trucks unload their waste onto the floor, into a pit, or directly into a waiting transfer container or vehicle. Direct loading can simplify operations, but limits the opportunity to perform waste screening or sorting. When not loaded directly, waste deposited onto the floor or into a pit is stored temporarily, then loaded into a transfer trailer, intermodal container, railcar, or barge. Most modern transfer stations have enclosed buildings. Some older and smaller facilities are partly enclosed (e.g., a building with three sides) or only covered (e.g., a building with a roof but no sides). Small rural facilities might be entirely open but surrounded by fences that limit access and contain litter.

Figure 3 shows the main transfer building for the site plan depicted in Figure 2. It shows a 40,000-square-foot building with a pit, separate tipping areas for public versus large trucks on either side of the pit, and a preload compactor to compact the waste before it is loaded into transfer trailers.

Because the main transfer building is typically quite tall to accommodate several levels of traffic, it can often be seen easily from off-site locations. Therefore, the main transfer building should be designed to blend into or enhance the surrounding neighborhood.

Types of Vehicles That Use a Transfer Station

Traffic is frequently a transfer station's most significant community impact. Because the primary purpose of transfer stations is to provide more efficient movement of wastes, it is important to consider the following types of customers and vehicles that commonly use them.

- **Residents hauling their own wastes in cars and pickup trucks.** Residents regularly served by a waste collection service typically visit the transfer station less frequently than residents in unincorporated and rural areas not served by waste collection companies (or who elect not to subscribe to an available service). Residents typically deliver only a few pounds to a ton of waste per visit.

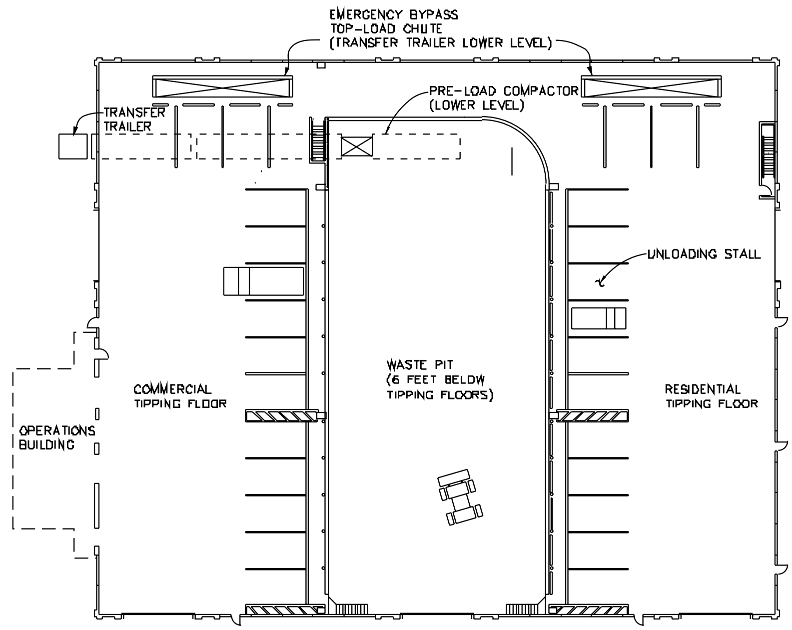
- **Businesses and industry hauling their own wastes in trucks.** Many small businesses such as remodeling contractors, roofers, and landscapers haul their own wastes to transfer stations. The vehicle type used and the waste amount delivered by businesses varies considerably.

- **Public or private waste hauling operations with packer trucks.** Packer trucks, which compact waste during the collection process, are commonly used on collection routes serving homes and businesses. Packer trucks typically visit many waste generators along their routes and unload when full, generally once or twice per day. Convenient access to a transfer station helps keep packer trucks on their collection routes. Packer trucks typically deliver 5 to 10 tons of waste per visit.

- **Public or private waste hauling operations with rolloff trucks.** Large rolloff containers are typically placed at businesses and industry and collected when they are full. A rolloff box is a large metal bin, often open at the top, that can be loaded onto a truck and hauled away to dispose of the waste. Rolloff boxes also are commonly used at transfer stations to receive yard waste, recyclables, and solid waste from the general public. A typical, large rolloff box measures 8 feet tall, 7 feet wide, and 22 feet long. Unlike packer trucks that operate on an extended route before traveling to the transfer station, rolloff trucks typically travel to one place, pick up a roll-off container, travel to and unload at the transfer station, and return the empty rolloff container to the place of origin. Because rolloff trucks handle many loads per day, convenient access to a transfer station is very important to their operations. Rolloff trucks typically deliver 2 to 8 tons per visit.

- **Transfer vehicles hauling waste from the transfer station.** Transfer trailers (similar to large interstate tractor-trailers) commonly haul consolidated waste from transfer stations to disposal facilities. Trains or barges are also used to haul waste from some large urban transfer stations (see text box). Transfer trailers typically haul 15 to 25 tons per trip, while trains and barges typically haul thousands of tons. Some stations

Figure 3
Main Transfer Building Floor Plan



Rural Transfer Station Design

Since small transfer stations in rural or tribal settings receive considerably lower volumes of waste and customer vehicles than large urban or suburban facilities, many of the design criteria outlined previously will simply not apply. Cost frequently is a major consideration for small rural transfer stations, limiting what can be done. Consequently, rural transfer stations are often uncovered or partially covered facilities. Partially covered sites might be enclosed on three sides with the vehicle entrance side open, or simply have a roof with no walls. A common design uses a single open-top trailer situated beneath a raised customer tipping area. The raised customer tipping area allows customers to back up to the trailer or drop boxes and directly unload their waste into the rolloff trailer. A hopper is not usually used. When constructing a raised tipping area, taking advantage of natural grades within the site can reduce construction costs. If favorable grades do not exist, a simple earthen retaining wall and access ramp can be constructed to create the multilevel layout desired. Some type of safety restraint should be incorporated on the tipping area to guard against falls. Using a removable constraint, such as a rope, chain, gate, or posts, allows tipping vehicles to unload waste unimpeded and facilitates site cleaning.

Driving surfaces ideally are paved to minimize dust generation, but all-weather gravel surfacing is a cost-effective alternative to asphalt pavement. Another alternative is hosing down dirt areas during operating hours. The use of drop boxes requires a concrete or asphalt pad. Ideally, the facility is surrounded by a fence and gated. The gate should be locked during nonoperating hours to keep out large vectors, trespassers, and illegal dumpers. Fences also are helpful in containing windblown litter. It is not uncommon for remote sites to lack water, sewer, or electrical service.

Partially covered rural facility.

Another design approach utilizes a completely contained modular system, such as the system pictured below. These types of systems are prefabricated and can be quickly assembled in the field. The waste collection bins are completely sealed and are animal- and people-proof. Waste is deposited into the sealed bin by one of two methods. A small sliding door on the front panel can be opened by hand allowing small waste loads to be deposited, while the entire front panel can be raised to allow collection vehicles to unload. Raising the front panel cannot be done by hand and requires a power source. For isolated sites lacking electrical power, vehicle drivers can use a power takeoff or a hydraulic connection from their collection vehicles to lift the front panel. To unload the system, the transfer vehicle pulls along side the container which is tipped up, dumping the waste into the waiting vehicle (see the photograph below). Again, if power is not available on site to tip the container, hydraulic power from the transfer vehicle itself can be used. This feature makes such arrangements ideal for unmanned or remote transfer stations. If desired, or required by state, tribal, or local regulations, leachate collection tanks also can be installed onsite.

An example of a modular, self-contained waste transfer system. Source: Haul-All Equipment Systems. 1999. Reprinted by permission of Haul-All Equipment Systems.

transfer materials by using intermodal systems, which combine short distance truck transport with longer distance rail or barge transport.

The following design issues should be considered for the various vehicle types:

- Packer trucks and rolloff trucks require a tall "clear height" inside buildings so they do not hit overhead lights, beams, or doorways when extended. When these vehicles unload, they typically require 25 to 30 feet of vertical clearance. Large transfer stations can more readily accommodate this requirement. Small and medium-sized transfer stations can provide this clearance, but doing so tends to make these buildings unusually tall for their size, particularly if they are multilevel facilities.

- Packer trucks and rolloff trucks need space on the tipping floor to pull forward as the load is deposited if they are unloading on a flat floor (rather than into a pit).
- Packer and rolloff trucks require large areas to turn, back up, and maneuver into the unloading area.
- Residential loads, particularly those pulling trailers, require additional time and space to back up into the unloading area. In the interest of safety and site efficiency, many transfer stations have a separate access road and receiving area for residential deliveries so that they do not tie up unloading space reserved for trucks. Residents typically unload materials by hand, which takes additional time.
- Curves and intersections along roads on or near the transfer station site need large turning radii so the rear wheels of trucks do not run over curbs or off the road when making moderate or sharp turns.
- Slopes on ramps should be limited to less than 8 percent, particularly for fully loaded transfer trailers.
- In colder climates, measures and equipment for seasonal or severe weather should be incorporated. Road sanders and snowplows for ice and snow removal are some examples.

A collection vehicle dumps its load onto the tipping floor.

Transfer Technology

The method used to handle waste at the transfer station from the time it is unloaded by collection vehicles until it leaves the site is central to any transfer station's design. In the simplest cases, waste from collection vehicles is unloaded directly into the transfer container or vehicle. As this eliminates opportunities to inspect or sort the material, other floor tipping methods are more common.

This section describes the basic methods of handling waste at transfer stations, explains which methods are most appropriate for small and large transfer stations, and addresses the

Rail and Barge Transport

Rail Transport is suitable for high-volume transfer stations, particularly those that need to haul waste long distances. Using railcars for transport offers some advantages over long hauling via truck. Railcars have a very large capacity and offer an economical mode of long-haul transport. Rail transport also eliminates highway out-haul traffic and allows out-haul vehicles to avoid highway traffic delays. Similar to trucks, rail transport uses a range of waste transfer containers and loading methods. Rail operations typically use direct top loading of noncompacted waste, loading of precompacted waste into intermodal containers, or placement of bales in conventional boxcars. When intermodal containers have to travel public highways between the rail terminals and either the transfer station or the disposal site, the container load must stay within the highway weight limit. In some cases this may mean using several smaller containers per railcar rather than just one or two large containers. A single train can take more than two hundred truck trips off the highway and in many situations can move the waste at a lower cost per ton mile, with greater fuel efficiency and lower overall air emissions.

Rail transport is dependent upon the availability of adequate numbers of rail cars and containers and the ability of the railroad system to pickup and move the waste in a timely manner. Long delays before departure or along the route can result in odor problems.

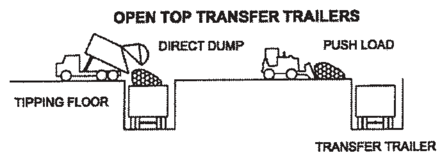
Barges carrying sealed intermodal containers are even more efficient than train transport. A single barge can replace 350 truck trips. Barge transport is best suited for very large waste transfer operations because of the high capital cost of loading and unloading terminals and transport containers and marine vessels. Siting of marine terminals may also be more difficult than siting a conventional waste transfer station.

Figure 4

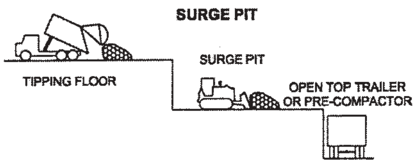
Basic Transfer Station Technologies

Waste can be unloaded directly into the "open top" of the trailer, but is most often unloaded on the tipping floor to allow for materials recovery and waste inspection before being pushed into the trailer. Large trailers, usually 100 cubic yards or more, are necessary to get a good payload because the waste is not compacted. This is a simple technology that does not rely on sophisticated equipment (e.g., compactor or baler). Its flexibility makes it the preferred option for low-volume operations.

A.



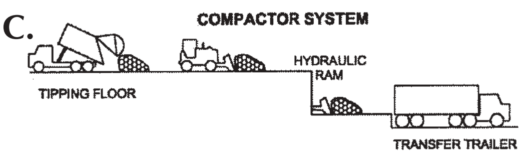
B.



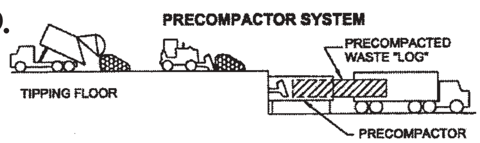
The surge pit is not a loading technology, but an intermediate step normally used with open-top or precompactor systems. The pit can store peak waste flow, thus reducing the number of transfer trailers needed. A tracked loader or bulldozer is used to compact the waste before loading, increasing payload. Because waste is often unloaded directly into the surge pit, this technology might deter materials recovery and waste screening efforts.

Stationary compactors use a hydraulic ram to compact waste into the transfer trailer. Because the trailer must be designed to resist the compactive force, it is usually made of reinforced steel. The heavy trailer and the weight of the onboard unloading ram reduce the payload available for waste. This technology is declining in popularity.

C.



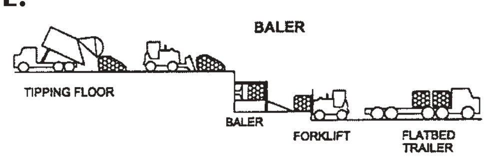
D.



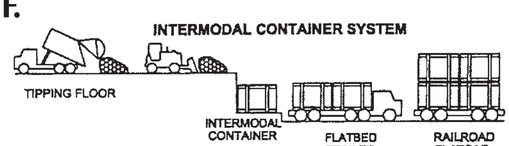
Precompactor systems use a hydraulic ram inside a cylinder to create a dense "log" of waste. The log is pushed into a trailer that uses "walking floor" technology to unload or relies on a tipper at the landfill to unload by gravity. Most precompactor installations have two units in case one unit requires repair. The capital cost is relatively high at more than $250,000 per unit, but the superior payload can offset these initial costs.

Balers are units that compress waste into dense, self-contained bales. Wire straps may be used to hold the bales intact. They are usually moved by forklifts and transported by flatbed trailers. The baler units can also be used for recyclables such as paper and metal. Payloads are very high, but so are capital costs. Most baling stations have at least two units in case one is down, and they cost more than $500,000 apiece. This high-technology option is normally used only in high-volume operations, and special equipment or accommodations might be required at the landfill (or balefill).

E.



F.



In this alternative, waste is tipped at a transfer station, then loaded into intermodal containers. These containers typically have moisture- and odor-control features and are designed to fit on both flatbed trailers and railroad flatcars. The containers may be loaded directly onto railcars or transferred by truck to a train terminal. The sealed containers can be stored on site for more than 24 hours until enough containers are filled to permit economic transport to the landfill. At the landfill, these containers are usually unloaded by tippers. This option allows for reduction of total truck traffic on local roads and can make distant disposal sites economically viable.

Source: DuPage County. 1998. *Solid Waste Transfer in Illinois: A Citizen's Handbook on Planning, Siting and Technology*. Reprinted by permission of DuPage County.

advantages and disadvantages of each method. Figure 4 shows simple diagrams of the various transfer methods described in this manual.

Options for unloading waste from collection or residential vehicles at the transfer station include:

- Directly unloading material into the top of a container or transfer trailer parked below the unloading vehicle, or onto a tipping floor at the same level as the unloading vehicle (Figure 4-A).
- Unloading into a surge pit located below the level of the unloading vehicle (Figure 4-B).

Waste can be moved and piled for short-term storage on the tipping floor or in a pit. Short-term storage allows waste to be received at the transfer station at a higher rate than it leaves the facility, increasing a transfer station's ability to handle peak waste delivery periods.

Options for reloading waste into a transfer container or vehicle include:

- Reloading directly from a tipping floor or pit into top-load containers or transfer trailers parked below the tipping floor or pit (Figures 4-A and 4-B).
- Reloading into a compactor that packs the waste into the end of a container or transfer trailer (Figure 4-C).
- Reloading into a preload compactor that compacts a truckload of material and then ejects the compacted "log" into the end of a container or transfer trailer (Figure 4-D).
- Reloading into a baler, which makes bales that can then be forklifted onto a flatbed truck (Figure 4-E).

Options for unloading waste at the disposal facility from transfer containers or vehicles include push-out blades, walking floors, and trailer tippers. With push-out blades and walking floors, the trailers unload themselves. A trailer tipper lifts one end of the trailer (or rotates the entire trailer) so that the load falls out due to gravity. Baled waste can be manipulated at the landfill using forklifts.

A trailer tipper emptying a transfer trailer at a waste disposal facility.

Table 1 summarizes the advantages and disadvantages of the various transfer technologies. Some transfer stations use a combination of technologies to mitigate some of the disadvantages of a particular design. For example, large transfer stations might have a top-loading system as a backup in case the preload compactor breaks down or in case of an electric power outage. It also illustrates that many interrelated factors need to be considered when deciding on the appropriate technology for a transfer station. The major factors include design capacity, distance to the disposal site, cost, reliability, safety, and method of unloading at the disposal site.

Transfer Station Operations

This section describes transfer station operations issues and suggests operational practices intended to minimize the facility's impact on its host community. Issues covered include:

- Operations and maintenance plans.
- Facility operating hours.
- Interacting with the public.
- Waste screening.
- Emergency situations.
- Recordkeeping.

Operations and Maintenance Plans

Although a transfer station's basic function as a waste consolidation and transfer facility is straightforward, operating a successful station involves properly executing many different tasks. Some tasks are routine and easily understood, while others occur infrequently and might be difficult to conduct properly without step-by-step directions. To help ensure proper operations, transfer stations should have written operations and maintenance plans. These plans are often required by

Table 1

Advantages and Disadvantages of Different Transfer Technologies

Waste Storage Alternatives

Technology	Advantages	Disadvantages	Application
Direct dump into transfer vehicle or storage container	Simple arrangement; little potential for equipment breakdown. Low capital cost. Potentially less housekeeping: no tipping floor, pit, or compaction equipment to clean and maintain. Much smaller building footprint possible, but advantage might be decreased by need for large yard space for queuing.	Transfer station cannot accept waste unless a trailer is positioned to receive waste. (Shortage of empty trailers shuts down facility.) No short-term storage (surge capacity) to accommodate peak inflow periods. Unless many unloading stalls are provided, long customer queuing can be expected during peak inflow periods. Relatively low payloads in trailers. Fall hazard. Limited ability to screen and remove unacceptable wastes. No opportunity for waste diversion or materials recovery. Generally not suitable for receiving loads from large roll-offs or large packer trucks. Trailers can be damaged by direct dumping of heavy materials.	Most suitable for small transfer stations in rural and tribal settings with a relatively short haul distance to the waste disposal site. Frequently used in conjunction with bins for source-separated recyclables.
Tipping floor waste storage	Simple arrangement; little potential for equipment breakdown. Generally less expensive and provides more operational flexibility than pits. Storage provides "disconnect" between waste receipts and waste loading. (Shortage of empty trailers does not shut down facility.) Allows for easy screening and removal of unacceptable wastes.	Garbage on tipping floor can be messy and slippery (fall hazard). Potential for accidents between customers and transfer station mobile equipment (e.g., wheel loader) that moves/stacks waste (safety issue). Requires roll-out space for trucks to pull forward when discharging their loads. Equipment is needed to reload the waste into the transfer trailer.	Suitable for small and large transfer stations; can manage nearly all waste types.

	Allows for the breaking up of bulky items and the compacting of waste to increase density for more economical shipping.	Requires additional fire control equipment (e.g., fire hoses, water cannon) to control fires in waste piles on tipping floor	
Surge pit	Storage provides "disconnect" between waste receipts and waste loading. (Shortage of empty trailers does not shut down facility.) Allows for the breaking up of bulky items and the compacting of waste to increase density for more economical shipping. No roll-out space required for unloading vehicles; waste falls from back of truck into pit. Eliminates potential for collision between transfer station equipment and customers.	Expensive to construct. Fall hazard for people and vehicles. Hazards to equipment operator working in pit when waste is being unloaded by customers. Can be difficult to remove unacceptable waste found in the pit. Extra building level (three stories instead of two) might increase overall height of building above grade, increasing building profile. Equipment is needed to reload the waste into the transfer trailer. Requires additional fire control equipment (e.g., fire hoses, water cannon) to control fires in waste piles in surge pit.	Most suitable for large transfer stations with high peak flows.

Transfer Container and Vehicle Loading Alternatives

Technology	Advantages	Disadvantages	Application
Top-loading trailers and containers	Simple, gravity-loaded method. Might be supplemented with compaction by using equipment that reaches into the top of the trailer to tamp down and level the load. Suitable for a wide range of waste types, including construction debris and bulky materials.	Generally involves imperfect, permeable closure (screen or tarp) on top of trailer. Odors and litter can escape, and precipitation can make the load heavier. Trailers can be damaged when dense or sharp materials fall into an empty trailer. Sound of waste falling into trailers can be noisy.	Suitable for small and large transfer stations.

Transfer Container and Vehicle Loading Alternatives (cont.)

Technology	Advantages	Disadvantages	Application
Compaction into trailer and container	A trailer or container can be completely closed to prevent rainwater entry and odor and liquid from escaping. Compaction usually achieves high densities.	A heavy trailer or container decreases effective payload. (Trailer must be structurally reinforced to withstand the pressure of the compactor.) Capital cost of trailer fleet is greater. Tail end of trailer or container (near compactor) tends to become overloaded. Front end of trailer tends to be light. Rear axle loading tends to limit effective payload. Hydraulic power equipment for compactor can be noisy.	Not commonly used for new transfer stations.
Preload compaction into rear-loading trailer or container	Allows use of lightweight trailer or container to increase effective payload. Trailer or container can be completely closed to prevent rainwater entry and odor and liquid from escaping. Payload can be measured as it is compacted, with ability to optimize each payload.	High capital costs (but can be offset by reduced transportation costs). Relatively complex equipment; when it breaks down, can shut down transfer station after short-term storage capacity is full. Redundancy (i.e., two compactor units) increases costs. Totally dependent on availability of electrical power. Large motor sizes generally preclude the use of a standby electrical generator to handle power outage. Less suitable for certain types of waste (oversize materials, concrete, wire, cable). Hydraulic power equipment for compactor can be noisy. A heavy electrical power consumption system.	Most suitable for high-volume transfer stations, particularly those that need to haul waste long distances. Container alternative ideally suited for intermodal transfer to rail system.

Baling	Allows for efficient transportation due to density of waste and ability to use light-weight trailers. Trailer can be completely closed to prevent rainwater entry, and odor and liquid from escaping. Compatible with balefills, which can landfill a large amount of waste in a small space; might be best in difficult (extreme weather or windy) environments. Baler can also be used to prepare recyclables for transport and sale.	High capital cost. Relatively complex equipment; when it breaks down, it can shut down transfer station after short-term storage capacity is full. Hydraulic power equipment for baler can be noisy. Special equipment needed at landfill.	Suitable for large transfer stations, particularly those that need to haul waste long distances. Required for delivering waste to a balefill.

Transfer Container and Vehicle Unloading Alternatives

Technology	Advantages	Disadvantages	Application
Push-out blade transfer trailer	Allows for unloading anywhere (not just at a landfill with a trailer tipper).	Some trailer capacity (both volume and weight) used for the push-out blade, which reduces effective waste payload. Material can become stuck behind push-out blade. Blade can bind during extension or retraction.	Most suitable for short-distance, low-volume hauling.
Walking floor transfer trailer	Allows for unloading anywhere (not just at a landfill with a trailer tipper).	More prone to leak liquids from the bottom of the trailer. More prone to damage from dense or sharp objects that fall into an empty trailer.	Suitable for a range of volumes and distances.
Trailer tipper for transfers trailers and trailer-mounted containers	Allows use of lightweight trailers to maximize payloads. Ideal for rail-based container intermodal system.	High reliability or redundancy required—no way to unload trailers at the landfill if the tipper fails. Tippers can be unstable if placed over waste at landfill.	Most suitable for long-distance, high-volume hauls. Most suitable for hauls to large landfills (small to medium landfills not likely to have a tipper).
Open-top railcar tippers	Extremely rapid, large-volume unloading.	Fixed unloading point requires reloading and some other form of transport from unloading point to final destination.	Most suitable for a fixed-disposal method such as at a solid waste incinerator.

Solid waste baler compacts waste into dense, self-contained bales.

state, tribal, or local regulations. They should be written specifically for a particular facility and include the following elements:

- Facility operating schedule, including days of the week, hours each day, and holidays.
- Staffing plan that lists duties by job title, minimum staffing levels, and typical work schedules.
- Description of acceptable and unacceptable wastes, and procedures for diverting restricted waste before and after unloading.
- Operating methods for each component of the facility, including waste-screening methods, truck-weighing procedures, tipping floor operations, transfer vehicle loading, onsite and offsite litter cleanup, and wastewater collection system operations.
- Description of maintenance procedures for each component, including the building, mobile equipment, utilities, and landscaping.
- Employee training.
- Safety rules and regulations.
- Recordkeeping procedures.
- Contingency plans in the event of transfer vehicle or equipment failure, or if the disposal site is unavailable.
- Emergency procedures.

Facility Operating Hours

A transfer station's operating hours must accommodate the collection schedules of vehicles delivering waste to the facility. Operating hours need to consider the local setting of the transfer station, including neighboring land uses, as well as the operating hours of the disposal facility receiving waste from the transfer station.

Operating hours vary considerably depending on individual circumstances. Many large facilities located in urban industrial zones operate 24 hours, 7 days per week. Urban, suburban, and rural transfer stations of various sizes commonly open early in the morning (6 a.m. to 7 a.m.) and close in the late afternoon (4 p.m. to 5 p.m.). In many cases, the last trailer must be loaded with sufficient time to reach the disposal site before it closes (typically 4 p.m to 6 p.m.).

Transfer stations that serve both the general public and waste hauling companies typically operate 6 or 7 days per week. Facilities that are not open to the public typically operate 5 or 6 days per week because many waste hauling companies do not operate on Sundays and have limited operations on Saturdays. Many smaller and rural facilities operate only on certain days of the week and have limited hours.

The hours described above represent when the transfer station is open to receive waste from customers. Operations often extend beyond the "open for customers" hours, however, as workers load waste into transfer vehicles, clean the facility, and perform equipment maintenance. Depending on the nature of the operation, transfer trucks leaving the site can sometimes operate on a schedule somewhat independent of the rest of the operations. For example, some operations maintain an inventory of empty transfer containers and vehicles and loaded containers and vehicles at the transfer station site. Loaded containers and vehicles can be hauled off site according to the best schedule considering traffic on area roadways, neighborhood impacts of truck traffic, and the hours the disposal facility receives waste from the transfer station. State, tribal, or local regulations might limit the overnight storage of waste in the transfer station or even in transfer trailers.

Interacting With the Public

Every transfer station has neighbors, whether they are industrial, commercial, residential, or merely vacant land. The term "neighbor" should be broadly interpreted, as some of those impacted might not be immediately adjacent to the transfer station. For example, vehicles traveling to and from a transfer station could significantly affect a residential neighborhood a mile away if those vehicles travel on residential streets.

An important part of successful transfer station operations is engaging in constructive dialogue with the surrounding community. The appropriate level of interaction between transfer station personnel or representatives and their neighbors varies depending on many factors. A transfer station in the middle of a warehouse district with direct access to expressways might find that joining the local business association and routinely picking up offsite litter are adequate community activities. While a transfer station located adjacent to homes and restaurants might find that monthly meetings with neighbors, landscaping improvements, commitments to employ local workers, an odor reporting hotline, and daily cleanup of litter are more appropriate.

When developing a community outreach plan, transfer station operators should consider the following:

- Develop a clear explanation of the need for the transfer station and the benefits it will provide to the immediate community and surrounding area.
- Develop a clear process for addressing community concerns that is communicated to the neighborhood even before the facility becomes operational.
- Designate one person as the official contact for neighborhood questions and concerns. Ideally, this person would regularly work at the transfer station and be available to respond quickly to questions and concerns. The person should also be good at listening carefully to community concerns before responding. Advertising an e-mail address or Web site is another way to provide information and allow community input.
- Organize periodic facility tours. Neighbors unfamiliar with the transfer station's operations are more likely to have misconceptions or misunderstand the facility's role.
- Establish positive relationships by working with community-based organizations, improvement districts, civic associations, business associations, youth employment bureaus, and other organizations. Interaction with the community should focus on positive issues, not just occasions when a neighbor is upset about odor, litter, or traffic.
- Offer support services such as newspaper drives, household hazardous waste (HHW) drop-off days, and spring cleaning disposal at the facility.

Waste Screening

As described in the section on Unacceptable Wastes in the Planning and Siting a Transfer Station chapter, some types of wastes are not appropriate for handling at a transfer station. These unacceptable wastes might be difficult to handle, dangerous, prohibited at the disposal facility where the waste is sent, or subject to a recycling mandate.[3] Transfer station operators should screen for unacceptable materials before, during, and after customers unload, and should tell customers where they can dispose of wastes inappropriate for that transfer station.

If their wastes are refused at a transfer station, some customers might illegally dispose of unacceptable materials or might try to hide these materials in a future delivery. When customers arrive with unacceptable materials, operators could give them a preprinted fact

3 For example, some states, tribes, or cities prohibit the disposal of yard wastes in landfills. Thus, grass clippings would be prohibited in a mixed waste load.

sheet that describes the issue and suggests alternative management methods. In addition, community programs dedicated to reducing the use of products that generate dangerous wastes can decrease unacceptable waste deliveries to transfer stations.

At the transfer station, screening for unacceptable wastes could start at the scale house (where customers first check in upon arrival at the facility). Employee training on identifying and managing suspect materials is the cornerstone in any waste-screening program. Operators could interview customers about types of waste they have and from where the waste was collected. A list of common unacceptable items could be posted, and operators could ask if any of the items are present in the load. Visual inspections can also help identify unacceptable wastes. Some facilities provide overhead cameras or walkways to facilitate a view of the top of uncovered loads (or loads that can easily be uncovered at the scale house). Walking around the truck to examine its contents and checking for smoke or suspicious odors might be appropriate. Sensors for detecting radioactive materials can be used at the scale house or at a point along the incoming truck route to the tipping area.

Fact Sheets About Unacceptable Waste

Consider developing simple fact sheets to inform customers why certain wastes are not accepted at the transfer station and where they can dispose of the unacceptable wastes. A typical fact sheet could include:

- A picture or graphic of unacceptable waste.
- A definition of what the unacceptable waste is and a brief description of why it is not accepted at the transfer station.
- The dangers, drawbacks, or penalties for improper disposal of unacceptable waste.
- Safe consumer alternatives.
- Where the waste can be appropriately managed, including driving directions, hours of facility operation, and contact information.
- Telephone numbers and Web sites of appropriate regulatory agencies that can provide more information.

Some unacceptable wastes might not become apparent until the unloading process. Operators should observe waste unloading and examine suspected unacceptable wastes. Waste unloaded onto the floor or into a pit is easier to monitor than waste unloaded directly into a transfer container or vehicle. Ideally, unacceptable wastes would be noticed before the delivery vehicle has left the site.

Regardless of screening efforts, transfer station operators should expect that some unacceptable wastes will be discovered after the responsible party is gone. Transfer stations should set aside an area for safe temporary storage of unacceptable wastes until appropriate disposal is feasible, and develop a step-by-step plan to follow. In some cases, the party that deposited the waste can be contacted to retrieve it. In other cases, the transfer station operator must properly manage the waste. Proper material management depends on the type of waste discovered. For example, management of hazardous wastes requires compliance with federal regulations issued under authority of the Resource Conservation and Recovery Act (RCRA) (40 CFR Parts 260 to 299) or the Toxic Substances Control Act (TSCA) (40 CFR Part 700 to 799), whereas recyclable materials screened from the waste stream can be collected and processed with similar materials.

Emergency Situations

Most days at a transfer station involve routine operations. Transfer station operators should prepare for emergencies, however, and include emergency procedures in their written operations plans. State regulatory agencies often require submission of a Plan of Operations and a Contingency Plan for review and approval. At minimum, the following emergency events should be anticipated:

- **Power failure.** The plan should address how to record customer information, collect fees, and load transfer trailers during a power outage. Many larger transfer stations have backup power generators so at least some operations can continue during a power failure.
- **Unavailability of transfer vehicles.** The plan should address what to do if poor weather, road closures, or strikes prevent empty transfer vehicles from arriving at the transfer station. The plan should also address when the transfer station should

stop accepting waste deliveries if the waste cannot be hauled out in a timely manner.

- **Unavailability of scales.** The plan should describe recordkeeping and fee assessment in the event that scales are inoperable. At facilities with both inbound and outbound scales, one scale can temporarily serve both purposes.
- **Fire.** Fire response and containment procedures should address fires found in incoming loads, temporary storage at the transfer station, compaction equipment, transfer vehicles, and other locations. Typically, fire procedures focus on protecting human health and calling professional fire departments. Ceiling sprinkler systems by themselves might not be completely effective in preventing small fires from spreading. Due to the high ceilings common in transfer stations, a fire could spread substantially before it gets hot enough at the ceiling level to activate sprinkler systems. Consequently, facilities should have fire hoses or other fire fighting equipment in the area, in addition to ceiling mounted sprinklers. A water cannon on a washer truck can also be used to contain small fires until the fire department arrives.
- **Spill containment.** Spills can occur from waste materials or from vehicles delivering waste. For example, hydraulic compaction system hoses on garbage trucks can break. Spill containment plans should address spill identification, location of spills, deployment of absorbent materials, and cleanup procedures. For large spills, the plan should also address preventing the spill from entering storm drains or sewers.
- **Discovery of hazardous materials.** Hazardous materials plans should include methods to identify and isolate hazardous materials, temporary storage locations and methods, and emergency phone numbers.
- **Injuries to employees or customers.** The plan should include first aid procedures, emergency phone numbers, and routes to nearby hospitals.
- **Robbery.** Some scale houses handle cash and include security provisions to deter robbery.

A transfer station scale house.

Emergency plans should include a list of emergency contacts, including daytime and evening phone numbers for facility management, facility staff, emergency response teams, frequent customers, and regulatory agencies.

Recordkeeping

Detailed operating records enable both facility managers and regulatory overseers to ensure that the transfer station is operating efficiently and in accordance with its permit requirements. Medium and large transfer stations typically record the following information as part of their routine operations:

- **Incoming loads:** date, time, company, driver name, truck number (i.e., company fleet number), weight (loaded), weight (empty),[4] origin of load, fee charged.
- **Outgoing loads** (typically transfer trucks): date, time, company, driver name, truck number (i.e., company fleet number), weight (loaded), weight (empty), type of

4 For repeat customers, the empty truck (tare) weight is often kept on file so trucks do not need to weigh out during each visit.

Urban Transfer Station Design and Operations

All transfer stations must address issues such as noise, odors, dust, vectors, traffic, and litter. Urban transfer stations, however, frequently lack the key component that suburban and rural facilities use to mitigate these problems: space. Where a suburban or rural facility can simply use large buffer zones between operations and receptor populations, urban sites are frequently unable to do so due to severe site size limitations. Urban transfer stations must employ a combination of planning, design, and operating practices to help minimize impacts upon the surrounding community. Listed below are several engineering designs, technologies, and operating practices that an urban transfer station should consider employing to mitigate facility impacts upon the neighboring community.

Noise

Structural and Site Layout Approaches

- Totally enclose all waste-handling operations to contain noise.
- Use concrete walls and structures, which absorb sound better than metal structures.
- Install double-glazed windows which contain noise better than single-glazed windows.
- Install shielding or barriers, such as trees, berms, or walls, around the facility to block and absorb noise. Size of the shielding, distance to receptors, and shielding materials all determine effectiveness. Walls can be made from concrete, stone, brick, wood, plastic, metal, or earth. Vegetate berms with grasses, shrubs, or trees to further mitigate noise and increase aesthetics. Barriers should be continuous, with no breaks, and long enough to protect the intended receptors.
- Wing walls, usually constructed of concrete, on transfer buildings can also block noise from trucks entering and exiting the building and noise from interior operations.
- Insulate transfer building walls with sound-absorbing materials.
- Locate administrative buildings between sources of noise and community.
- Orient transfer building openings (i.e., doors) away from receptors.

Operational Practices

- Keep doors closed during operating hours, except when vehicles are entering or exiting.
- Use the lowest allowable setting on vehicle backup alarms, or use visual warning devices if state and local regulations allow.
- Establish operating hours that avoid early morning or late-night operations.
- Set facility noise level limits (e.g., 55 decibels at the site boundary) and adhere to them.

Odors

- Remove all waste at the end of each operating day. Do not allow any waste to remain on site overnight.
- Frequently clean/wash down the tipping floor or surge pit.
- Install misting systems with deodorants to mask or neutralize odors. Be prepared to make seasonal adjustments as needed to control odors.
- Install ventilation systems with air filters or scrubbers.
- Plant vegetative barriers, such as trees, to absorb and disperse odors.
- Use odor vestibules on truck entrances and exits. Odor vestibules are 2-door systems in which the outer door closes before inner door opens to prevent odors from escaping.
- Install plastic curtains on entrances and exits to contain odors when doors are opened to allow vehicles to enter or exit.
- Use biofilters – which pass malodorous air through organic matter, such as wood chips, mulch, or soil – to capture odor molecules. Bacteria in biofilters consume and neutralize odor molecules.
- Set up a community "odor complaint" phone line, and respond to community complaints.

Dust

Dust from Vehicles

- Pave all roads on site, or lay gravel as a less expensive option.
- Clean facility roads frequently with street-sweeping equipment.
- Wash waste collection vehicles before they leave the transfer station to remove dust-generating dirt and debris.

Dust from Waste Handling Operations

- Align building openings to minimize exposure to prevailing winds.
- Install plastic curtains over building openings.
- Keep station doors closed during operating hours, except when trucks are entering or exiting.
- Install misting systems over tipping areas to "knock down" dust particles. Misting system operations should be adjusted seasonally or as the dryness of the waste dictates.

Vectors (e.g., rats, mice, cockroaches, and other insects)

- Hire a professional licensed pest control company with expertise and experience in controlling specific vector populations.
- Seal or screen openings that allow rodents and insects to enter the building, such as door and window frames, vents, and masonry cracks. Also check for and repair chewed insulation at points where utility structures, such as wires and pipes, enter the transfer building.
- Treat insect breading areas and eliminate as many of these breading areas as possible. Implement practices that do not create new breeding areas.
- Implement practices that reduce the likeliness of attracting vectors (e.g., remove all waste at the end of the operating

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day, wash tipping areas daily, pick up litter and other debris daily).

- Some municipalities require transfer stations to pay neighbors' extermination/pest control costs if it can be proven that the facility is the source of the problem. Consider this policy even if it is not required by law.

Traffic

- Create acceleration, deceleration, or turning lanes at site entrances and exits as needed to maintain steady traffic flows around facility. This may require widening roads.
- Fund road improvements and upgrades around the facility to reduce congestion and prevent damage from additional truck traffic.
- Work with the community to designate inbound and outbound truck traffic routes and ensure that drivers follow these routes.
- Do not allow incoming trucks to queue on public streets. If inadequate space is available on site to accommodate waiting trucks, use a remote site as a waiting area for the trucks. Use radios to dispatch trucks from the waiting area to the transfer station.
- Where possible, schedule incoming traffic so that it does not coincide with local rush hours.

Litter

- Require all incoming and outgoing loads to be covered.
- Ensure that all incoming and outgoing trucks are leak-proof to avoid leachate spills on public streets.
- Implement daily litter inspections and pickup at the facility and on surrounding streets.
- Install a perimeter fence to prevent windblown litter from leaving the site.

material (e.g., waste, compostables, recyclables), destination of load.

- **Facility operating log:** noting any unusual events during the operating day.
- **Complaint log:** noting the date, time, complaining party, nature of the complaint, and followup activity to address the complaint.
- **Accidents or releases:** details any accidents or waste releases into the environment.
- **Testing results:** such as tests for suspected unacceptable waste.
- **Environmental test results:** such as surface water discharges, sewer discharges, air emissions, ground-water, or noise tests.
- **Maintenance records:** for mobile and fixed equipment.
- **Employee health and safety reports.**
- **Employee training and operator certification documentation.**

Some transfer station operators, particularly at smaller facilities, find it necessary to record only some of the above items. In order to avoid the cost of installing and operating a scale, some small and medium-size transfer stations substitute estimated load volume (as measured in cubic yards) instead of weighing loads (in tons). When loads cannot be easily viewed (such as with packer trucks), cubic yards are generally based on the vehicle's capacity. Loads in cars and pickup trucks are typically charged a minimal flat fee.

Environmental Issues

Developing transfer stations that minimize environmental impacts involves careful planning, designing, and operation. This section focuses on neighborhood quality or public nuisance issues and offers "good neighbor practices" to improve the public's perception of the transfer station. Design and operational issues regarding traffic, noise, odors, air emissions, water quality, vectors, and litter are discussed below. Proper facility siting, design, and operation can address and mitigate these potential impacts on the surrounding natural environment and the community.

Careful attention to these issues begins with the initial planning and siting of a facility and should continue with regular monitoring after operations begin. Transfer station design must account for environmental issues regardless of surrounding land use and zoning. Stations sited in industrial or manufacturing zones are subject to the same environmental concerns and issues as stations located in more populated zones. Minimizing the potentially negative aspects associated with these facilities requires thoughtful design choices. Identifying and

Depositing incoming waste on a tipping floor facilitates waste screening.

addressing these important issues can be a significant part of the overall cost to develop the waste transfer station.

Traffic

Traffic causes the most significant offsite environmental impacts associated with larger waste transfer stations. This is particularly true for stations in urban and suburban areas where traffic congestion is often already a significant problem for the local community. Although transportation routes serving rural stations typically receive less traffic, these routes might still be affected by limitations on gross vehicle weight or individual axle weights for certain roads or bridges.

By consolidating shipments to the disposal site, a waste transfer system will have net positive impacts in terms of reducing community-wide truck traffic, air emissions, noise, and highway wear. Some of these negative impacts, however, might be concentrated in the immediate vicinity of the transfer station as a result of increased local traffic generated by a transfer station, even though overall impacts are reduced.

Evaluating travel routes and the resulting traffic impacts should receive significant attention during facility siting and design to minimize the traffic's offsite environmental impacts. Furthermore, dependable access and smooth traffic flow are essential for good customer service and the operating efficiency of the facility. It is common, particularly in urban and suburban areas, for tribes and other local jurisdictions to require significant offsite improvements to mitigate traffic impacts or to assess traffic impact fees to offset improvements needed for traffic upgrades.

Typically, transfer stations can indirectly control when traffic arrives at the facility by adjusting operating hours. Relatively few transfer stations are able to schedule inbound traffic because collection vehicles need to unload when they are full so collection crews can resume their routes or end their working day. Also, many transfer stations are not operated by the same company delivering waste to the facility, so control over specific timing is difficult. Some transfer stations have the ability to schedule transfer vehicle traffic, however. These stations often schedule trips to avoid rush-hour traffic on area routes.

Any queuing should occur on the transfer station site so as not to inhibit the traffic flow on public streets. Queuing on streets creates public safety concerns, blocks traffic and access to adjacent properties, and in some cases, causes damage to streets not designed for heavy vehicles. Exhaust from idling truck engines queuing on public streets can also create air quality and health concerns. (See the Air Emissions section on page 37 for discussion of air emission issues.) If space on the site is insufficient, alternatives should be considered. These could include providing a separate tipping area for certain types of customers (such as self-haulers, who generate a lot of traffic, but not much waste) or establishing a remote holding lot for inbound vehicles to use before joining the onsite queue. Regulatory agencies sometimes can address and control queuing problems through the permitting process. Permitting agencies can incorporate provisions that require transfer stations to provide adequate queuing space on site or off site or that prohibit queuing on public streets.

As a result of community input, the operator might designate traffic routes to the facility. A simple "right turn only" at the exit can relieve some traffic conflicts. If offsite routes are designated, clear authority for enforcement needs to be established (e.g., by local police or by the station operator refusing access to violators).

Some specific design and operation features that might be necessary to reduce the environmental impacts of station traffic are described below:

- Designating haul routes to and from the transfer station that avoid congested areas, residential areas, and other sensitive areas.
- Adding offsite directional signs, pavement markings, and intersection signals.
- Providing acceleration and deceleration lanes that allow vehicles to enter and leave the flow of offsite traffic smoothly, reducing congestion and the likelihood of accidents.
- Using right turns to enter and leave the station site and minimizing left turns to reduce congestion and the likelihood of accidents off site.
- Providing adequate onsite queuing space so lines of customers and transfer vehicles waiting to enter the facility do not interfere with offsite traffic.
- Installing and using compaction equipment to maximize the amount of waste hauled in each transfer trailer, thus reducing the number of loads leaving the site.
- Establishing operating hours, including restrictions, that encourage facility use during nonpeak traffic times on area roads.
- Schedule commercial waste deliveries to avoid rush-hour traffic.
- Providing or requiring the provision of residential waste collection service to reduce the number of people hauling their own wastes to the transfer station. Although the transfer station will handle the same amount of waste, more of it will arrive as combined collection vehicle loads, reducing the number of loads brought in by cars and pickup trucks. (One residential collection vehicle can haul as much as 15 to 30 cars and pickup trucks.)

Noise

Transfer stations can be a significant source of noise, which might be a nuisance to neighbors.[5] Heavy truck traffic and the operation of heavy-duty facility equipment are the primary sources of noise from a transfer station. Offsite traffic noise in the station's vicinity will be perceived as noise from the station itself. Equipment noise includes engines, backup alarms (beepers), hydraulic power units, and equipment buckets and blades banging and scraping on concrete and steel surfaces. The unloading of waste or recyclables (particularly glass) onto a tipping floor, pit, steel drop box, or trailer can also create substantial noise, depending on the type of waste, fall distance, and surface. Stations that use stationary solid waste compactors or engine-driven tamping equipment have additional sources of mechanical equipment noise with which to contend. Good facility design and operations can help reduce noise emanating from the station. This includes:

- Maximizing the utility of perimeter site buffers, particularly along site boundaries with sensitive adjoining properties. Increasing the distance between the noise source and the receiver, or providing natural or man-made barriers are the most effective ways of reducing noise when the sound generation level cannot be reduced.

Noise Abatement: Leon County, Florida

As part of its site selection process for a waste transfer station, Leon County, Florida, commissioned a study to evaluate and address noise concerns. Parcels adjacent to the site include residential, commercial, and light industrial. To the west is undeveloped residential land. The study used a 5-step procedure to determine the impact that noise from the transfer station would have on the adjoining community. It also assessed the effectiveness and feasibility of abatement. The study resulted in nine recommendations relating to building orientation, truck routing, operating hours, berm and wall construction, and vegetative plantings to buffer noise (Leon County, FL; February, 2000).

5 Although repeated exposure to high noise levels can lead to hearing impairment, noise levels associated with impairment are typically a concern only to employees; neighborhood impacts are typically a nuisance issue, not a health issue.

- Orienting buildings so the site topography and the structure's walls buffer adjacent noise-sensitive properties from direct exposure to noise sources.
- Providing sound-absorbent materials on building walls and ceilings.
- Shutting off idling equipment and queuing trucks.

Surge pit separating public and commercial vehicles. Water sprays along the walls of the pit are used to suppress dust.

- Avoiding traffic flows adjacent to noise-sensitive property.
- Arranging the facility layout to eliminate steep uphill grades for waste-hauling trucks, as driving uphill can significantly increase noise levels.
- Facing building openings such as entrances away from noise-sensitive adjoining property.
- Considering alternatives for beeping back-up alarms, such as strobe lights and proximity detectors (if state and local regulations allow).
- Confining noisy activities within specified buildings or other enclosures. In particular, enclose hydraulic power units associated with compactors and rams in areas with acoustic silencing materials. Quieter equipment options can also be selected during design.
- Properly maintaining mufflers and engine enclosures on mobile equipment operating within the transfer station. Also insist that operators of commercial hauling vehicles keep their equipment, including the muffler systems, in good repair.
- Keeping as many doors closed during station operating hours as practical.
- Conducting activities that generate the loudest noise during selected hours, such as the morning or afternoon commute hours, when adjoining properties are unoccupied or when offsite background noise is at its highest.

Odors

MSW, food waste, and certain yard wastes such as grass have a high potential for odor generation. Odors might increase during warm or wet weather. Thus, transfer stations handling these wastes need to address odor management based on current and projected adjacent land uses. Odors can be managed with proper facility design and operating procedures, including:

- As with noise mitigation, increasing the distance between the odor source and the receiver effectively reduces the impact of odors.
- Evaluating the prevailing wind direction to determine building orientation and setback to adjacent properties.
- Carefully orienting the building and its doorways with respect to odor-sensitive neighboring property and closing as many doors as practical during operating hours.
- Designing floors for easy cleanup, including a concrete surface with a positive slope to drainage systems. Eliminating crevices, corners, and flat surfaces, which are hard to keep clean and where waste residue can accumulate.
- Sealing concrete and other semiporous surfaces to prevent absorption of odor-producing residues.

- Minimizing onsite waste storage, both in the facility and in the loaded trailers, by immediately loading odorous or potentially odorous wastes into transfer trailers and quickly transferring them to the disposal site.
- Incorporating odor neutralizing systems.
- Removing all waste from the tipping floor or pit at the end of each operating day, then cleaning those areas to remove remaining residues.
- Using enclosed trailers whenever possible when loaded trailers must sit on site temporarily before transfer.
- Practicing "first-in, first-out" waste handling practices so wastes are not allowed to sit on site for long periods of time.
- Collecting and removing partially full containers at rural stations where accumulation of full loads could take several days.
- Keeping building catch basins, floor drains and drainage systems clean so odor-causing residues do not build up.
- Treating drainage systems periodically with odor-neutralizing and bacteria-inhibiting solutions.
- Diverting odorous waste loads to facilities with less sensitive surroundings during adverse weather conditions.
- Refusing to accept certain highly odorous wastes.
- Practicing other "good housekeeping" measures, including regularly cleaning and disinfecting containers, equipment, and other surfaces that come into contact with waste.

Air Emissions

Air emissions at transfer stations result from dusty wastes delivered to the transfer station, exhaust (particularly diesel) from mobile equipment such as trucks and loaders, driving on unpaved or dusty surfaces, and cleanup operations such as street sweeping. As with odor control, proper design and operating procedures help minimize air emissions, including:

- Paving all traffic carrying surfaces.
- Keeping paved surfaces and tipping floors clean, and ensuring any street sweeping operations use sufficient water to avoid stirring up dust.
- Restricting vehicles from using residential streets.
- Selecting alternative fuel or low-emission equipment or retrofitting facility equipment with oxidation catalysts and particulate traps.
- Working with truck fleet operators to reduce exhaust emissions through the retrofit of emission control devices, use of cleaner fuels, and use of alternative fuel vehicles (e.g., compressed natural gas)
- Installing misting systems to suppress dust inside the building or using a hose to spray dusty wastes as they are unloaded and moved to the receiving vehicles. (In rural areas, small stations might not have a readily available water supply, or might have to rely on a portable water supply for housekeeping needs.)
- Maintaining engines in proper operating condition by performing routine tune-ups.
- Considering the purchase of newer generation, low-emission diesel engines.
- Minimizing idling of equipment by turning off engines when not in use. Truck stop electrification technology can be installed at designated queuing areas to provide truck cabs with comforts such as climate controlled air, electricity, and phone lines while engines are shut off.
- Cleaning truck bodies and tires to reduce tracking of dirt onto streets.
- Maintaining building air filtering systems so that they perform effectively.

Storm Water Quality

Rainfall and wash-down water flows from roofs, roads, parking lots, and landscaped

Water Quality at Rural Transfer Stations

At stations in rural areas where water might not be available for sanitary uses, portable toilets might provide a solution. But even at these stations, there is likely some amount of potentially contaminated runoff that needs to be managed as sewage. In rural areas and other areas not served by a piped sanitary sewer system, it is common to connect building drains to underground holding tanks. The tanks are pumped as needed, and the leachate is trucked to a sewage treatment plant or other approved processing facility.

areas at a transfer station, eventually reaching natural or constructed storm water drainage systems. Runoff might also percolate into the ground-water system. Keeping surface water free of runoff contamination from waste, mud, and fuel and oil that drips from vehicles is important to maintaining the quality of both the surface and ground water systems. The quality and amount of runoff often is regulated by state, tribal, or local water management authorities. Transfer station development typically results in the addition of new impervious surfaces (i.e., paved surfaces) that increase the total quantity of runoff and can contribute to flooding potential.

When runoff contacts waste, it is considered potentially contaminated and is known as "leachate." Transfer station design and operation should ensure that contaminated water is collected separately, then properly managed on site or discharged to the sewer. Most transfer stations send some amount of waste water to sewer systems. In addition to leachate, waste water from daily cleaning of the waste handling areas and the facility's restrooms and support areas typically are discharged to the sewer. Local waste water treatment plants establish guidelines for pretreatment and analysis with which transfer stations must comply when discharging waste water into the sewer. To minimize impacts on sewer systems, transfer stations should consider:

- Covering waste handling and storage areas that drain to the sanitary sewer system. This reduces the amount of rainfall contributing to the total volume of sewer flow.
- Removing as much debris from the tipping floor as possible by mechanical means (e.g., scraping or sweeping) before hosing the floor down.
- Installing drain covers on floor drains. During normal operations, floor drains should be covered to prevent spilled liquid wastes from entering the sewer system. Covers can be opened or removed during floor cleaning.
- Installing low-flow toilets, showers, and faucets.
- Providing appropriate pretreatment of water that comes into contact with waste (leachate). Pretreatment requirements vary depending on the capabilities of the receiving sewer, but could include provisions allowing solids to settle out of the sewage, the use of oil/water separators, or the use of other treatment systems.

Other design and operation measures to consider in managing surface water quality include:

- Complying with all surface water management regulations applicable in the jurisdiction where the station is located. In jurisdictions with well-developed regulations, design and operation measures usually include development of surface water detention facilities (ponds, tanks, or large holding pipes) that limit the runoff rate to the predeveloped rate. In addition, water quality requirements might involve desilting facilities and applying various forms of biofiltration to remove contaminants. Some jurisdictions might require pH adjustment and other forms of pretreatment.
- Locating stations outside local flood zones.
- Minimizing impervious areas and maximizing landscape and vegetative cover areas to reduce total runoff.
- Limiting outside parking of loaded containers or alternatively using rain-tight, leak-tight containers. If loaded containers or transfer vehicles are parked or stored outside, providing catch basins connected to

the sanitary sewer system might be necessary.

- Maintaining all surface water management facilities in good operating condition. This includes periodic cleaning and removal of silt and debris from drainage structures and ponds, as well as removing collected oil from oil-water separators.
- Responding promptly to exterior spills to prevent waste materials from entering the surface water system.
- Cleaning up liquid spills such as oils, paints, and pesticides with absorbent material rather than hosing them into drains. Although transfer stations generally do not accept these liquids, they might find their way into the waste stream in small quantities.
- Using secondary containment around temporary storage areas for HHW, batteries, and suspect materials.

Vectors

Vectors are organisms that have the potential to transmit disease. Vectors of concern at transfer stations can include rodents, insects, and scavenging birds. Seagulls are particularly troublesome birds in coastal zones and certain inland areas. Much of the concern surrounding vectors is associated with general nuisance factors, but this issue justifies diligent attention. A few basic design elements and operational practices can greatly reduce the presence of vectors, including:

- Eliminating or screening cracks or openings in and around building foundations, waste containers, and holding areas at enclosed-type stations. This reduces opportunities for entry by terrestrial vectors (especially rodents).
- Installing bird-deterrent measures, such as suspended or hanging wires to keep birds out of structures, and eliminating horizontal surfaces where birds can congregate.
- Removing all waste delivered to the facility by the end of each day.
- Cleaning the tipping floor daily.
- Routinely inspecting the facility for potential vector habitat, and taking corrective action when needed.
- Using commercial vector control specialists as necessary.

Litter

In the normal course of facility operations, stray pieces of waste are likely to become litter in and around the facility. In jurisdictions that do not have or do not enforce regulations to cover customer vehicles, the litter problem is often most prevalent on routes leading to the station. Dry, light materials such as plastic grocery bags can be blown from the backs or tops of vehicles, or from the tipping area to the facility's outside areas.

Design and operation considerations that can reduce the litter problem include:

- Conducting all waste handling and processing activities in enclosed areas, if possible.
- Orienting the main transfer building with respect to the predominant wind direction so it is less likely to blow through the building (or tunnel) and carry litter out. Generally the "blank" side of the building should face into the prevailing wind.
- Strictly enforcing the load covering or tarping requirements will reduce litter from waste trucks. Some transfer station operators have the authority to decline uncovered loads and have instituted surcharges to provide incentives for customers to cover their loads.
- Providing windbreaks to deflect wind away from waste handling areas.
- Locating doors in areas that are less likely to have potentially litter-producing materi-

Vector Control at Rural Transfer Stations

In less densely populated areas, other vectors of concern could include bears, raccoons, and dogs, especially if waste is not tightly enclosed. The best way to keep large vectors out of the facility is to totally enclose the waste storage area or to fence and gate the site. Bird-scare devices, such as recordings of predatory birds or plastic decoys, can help alleviate scavenging. Baited traps can be used to control rodents, and humane traps can capture larger mammals such as raccoons and weasels.

als stored near them, regardless of building orientation.

- At small rural stations, providing containers with lifting lids that are normally closed.
- Minimizing horizontal ledges where litter can accumulate.

Facility Operating Plans

Many states (as well as some tribes and local governments) require waste transfer stations to prepare and maintain facility operating plans. Often, these plans must be submitted with the permit application. The operating plan format and the specific information it must contain can vary greatly. Some states may also require operating plans prepared or certified by a licensed or certified professional engineer. Operating plans might require the following information:

- Facility-specific information such as location and ownership. Some states require maps and diagrams of the site and facility as well.
- Facility capacity and expected operating life.
- Description of the type of waste the facility will handle, including waste origination, composition, and weight or volume.
- A list or description of unacceptable wastes, including procedures for storing and handling these materials if they do arrive at the facility.
- A description of daily operations, including waste handling techniques, vector controls, and hours of operation.
- Emergency or contingency plans and procedures.

- Providing skirts (usually wide rubber belting or strip brushes) that close the gap between the bottom of the chute and the top of the receiving container at stations that employ chutes and hoppers to contain waste as it is deposited in trailers and drop boxes.
- Installing fencing and netting systems to keep blowing litter from escaping the station site. This is particularly necessary at small rural facilities that are likely open-sided or that lack an enclosing building.
- Conducting routine litter patrols to collect trash on site, around the perimeter, on immediately adjacent properties, and on approach roads and the hauling route(s). Litter patrols, especially at unattended sites, can also detect any illegal dumping that has occurred along the site perimeter.
- Cleaning the tipping floor regularly and maintaining good housekeeping practices. This will minimize the amount of loose material that can be blown outside.

Safety Issues

Thoughtful facility design coupled with good operating practices help ensure transfer stations are safe places. Transfer stations should be designed and operated for the safety of employees, customers, and even persons illegally trespassing when the facility is closed. Designers need to consider that people might trespass on facility grounds during operating hours or after the facility is closed for the night. Most state regulations require security and access control measures such as fences and gates that can be closed and locked after hours. Signs should be posted around the perimeter, with warnings about potential risks due to falls and contact with waste. Signs should be posted in multiple languages in jurisdictions with high percentages of non-English-speaking residents.

Federal Occupational Safety and Health Administration (OSHA) regulations require facilities to provide safe working conditions for all employees. Although regulations specific to waste transfer stations do not currently exist, general OSHA regulations apply as they would to any other constructed facility. State, tribal, and local workplace safety regulations, which can be more stringent than federal regulations, also might apply.

Some state, tribal, or local governments might require a facility's development permit to directly address employee and customer safety. State and tribal solid waste regulations, for instance, often require development of operating plans and contingency plans to address basic health and safety issues. Transfer station safety issues are the facility operator's responsibility.

This section describes general safety concerns associated with solid waste transfer stations. A facility must take steps to eliminate or reduce risk of injury from many sources, including:

Exposure to Potentially Hazardous Equipment

Transfer station employees work in close proximity to a variety of hazards, including equipment with moving parts, such as conveyor belts, push blades, balers, and compactors. Facility operators should develop an employee equipment orientation program and establish safety programs to minimize the risk of injury from station equipment. Utilizing locks or tags that prevent equipment from operating until they are removed (lockout/tagout systems), for example, effectively minimize hazards associated with transfer station equipment. Transfer stations operators must implement and strictly enforce rules requiring children and pets to remain in the vehicle at all times. Posting signs and applying brightly colored paint or tape to hazards can alert customers to potential dangers.

Personal Protective Equipment

Transfer station employees coming in close contact with waste and heavy machinery should wear appropriate personal protective equipment. Common pieces of protective gear include hard hats, protective eye goggles, dust masks, steel tipped boots, and protective gloves. If working in close proximity to loud machinery, hearing protection should be used as well. Check state and local codes and regulations to see if any personal protective equipment standards exist. Ensure that all facility employees are using the appropriate equipment and are properly maintaining it.

Exposure to Extreme Temperatures

Facilities located in areas of extreme weather must account for potential impacts to employees from prolonged exposure to heat or cold. Heat exhaustion and heat stroke are addressed with proper facility operations, including good ventilation inside buildings, access to water and shade, and periodic work breaks. Cold weather is addressed by proper clothing, protection from wind and precipitation, and access to warming areas. Extreme temperatures typically should not pose problems for customers because their exposure times are much less than those of facility workers.

Traffic

Controlled, safe traffic flows in and around the facility are critical to ensuring employee and customer safety. Ideally, a transfer station is designed so traffic from large waste-collecting vehicles is kept separate from self-haulers, who typically use cars and pickup trucks. Facility designers should consider:

Well marked, color-coded traffic routes can help minimize contact between commercial and public vehicles.

- Directing traffic flow in a one-way loop through the main transfer building and around the entire site. Facilities with one-way traffic flow have buildings (and sometimes entire sites) with separate entrances and exits. The transfer trailers, in particular, are difficult to maneuver and require gentle slopes and sufficient turning radii. Ideally, these trailers should not have to back up.
- Arranging buildings and roads on the site to eliminate or minimize intersections, the need to back up vehicles, and sharp turns.
- Providing space for vehicles to queue when the incoming traffic flow is greater than the facility's tipping area can accommodate. Sufficient queuing areas should be located

after the scale house and before the tipping area. This is in addition to and separate from any queuing area required before the scale house to prevent traffic from backing up onto public roads.

- Providing easily understood and highly visible signs, pavement markings, and directions from transfer station staff to indicate proper traffic flow.
- Providing bright lighting, both artificial and natural, inside buildings. Using light-colored interior finishes that are easy to keep clean is also very helpful. When entering a building on a bright day, drivers' eyes need time to adjust to the building's darker interior. This adjustment period can be dangerous. Good interior lighting and light-colored surfaces can reduce the contrast and shorten adjustment time.
- Providing an area for self-haulers to unload separately from large trucks. Typically, self-haulers must manually unload the back of a pickup truck, car, or trailer. This process takes longer than the automated dumping of commercial waste collection vehicles and potentially exposes the driver to other traffic. It is often a good idea to provide staff to assist the public with safe unloading practices.
- Requiring facility staff to wear bright or conspicuous clothing. Personnel working in the tipping area especially must wear high visibility clothing at all times.
- Installing backup alarms on all moving facility equipment and training all vehicle operators in proper equipment operations safety. Backup alarms must be maintained in proper working condition at all times. Cameras and monitors can also be installed as an additional precaution.

Falls

Accidental falls are another concern for facility employees and customers, especially in facilities with pits or direct dump designs where the drop at the edge of the tipping area might be 5 to 15 feet deep. Facilities with flat tipping areas offer greater safety in terms of reducing the height of falls, but they present their own hazards. These include standing and walking on floor surfaces that could be slick from recent waste material and being close to station operating equipment that removes waste after each load is dumped. Depending on the station design (pit or flat floor), a number of safety measures should be considered to reduce the risk of falls.

- For direct gravity loading of containers by citizens, a moderate grade separation will reduce the fall distance. For example, some facilities place rolloff boxes 8 feet below grade to facilitate easy loading of waste into the container (so the top of the rolloff box is even with the surrounding ground). This approach, however, creates an 8-foot fall hazard into an empty rolloff box. Alternatively, the rolloff box can be set about 5 feet below grade, with the sides extending about 3 feet above the floor. This height allows for relatively easy lifting over the box's edge, yet is high enough to reduce the chance of accidental falls.
- For pit-type operations, the pit depth can be tapered to accommodate commercial unloading at the deep end (typically 8 to 12 feet) and public unloading at the shallow end (3 to 6 feet).
- Safety barriers, such as chains or ropes, can be placed around the pit edges at the end of the day or during cleaning periods to prevent falls. These barriers, however, should be removed during normal operating hours as they are a trip hazard and can interfere with the unloading of waste.
- Substantial wheel stops can be installed on the facility floor to prevent vehicles from backing into a pit or bin. Some curbs are removable to facilitate cleaning.
- Locating wheel stops a good distance from the edge of the unloading zone ensures that self-haul customers will not find themselves dangerously close to a ledge or the operating zone for station equipment.
- To prevent falls due to slipping, the floor should be cleaned regularly and designed with a skid-resistant surface. Designers

need to provide sufficient slope in floors and pavements so that they drain readily and eliminate standing water. This is especially crucial in cold climate areas where icing can cause an additional fall hazard. Because of transfer stations' large size and volume and the constant flow of vehicles, it is impractical to design and operate them as heated facilities.

- Use of colored floor coatings (such as bright red or yellow) in special hazard zones (including the area immediately next to a pit) can give customers a strong visual cue.
- Designing unloading stalls for self-haul customers with a generous width (at least 12 feet when possible) maximizes the separation between adjacent unloading operations and reduces the likelihood of injury from activity in the next stall. For commercial customers, stall widths of at least 15 feet are needed to provide a similar safety cushion. This is particularly necessary where self-haul and commercial stalls are located side-by-side.
- If backing movements are required, design the facility so vehicles back in from the driver's side (i.e., left to right) to increase visibility.

Noise

Unloading areas can have high noise levels due to the station's operating equipment, the unloading operation and waste movement, and customer vehicles. Backup safety alarms and beepers required on most commercial vehicles and operating equipment also can be particularly loud. The noise level also might cause customers not to hear instructions or warnings or the noise from an unseen approaching hazard.

Designers have limited options for dealing with the noise problem. The principal way to reduce the effects of high-decibel noise in enclosed tipping areas is to apply a sound-absorbing finish over some ceiling and wall surface areas. Typically, spray-on acoustical coatings are used. These finishes have a drawback, however. They tend to collect dirt and grime and are hard to keep clean and bright. Using a rubber shoe on the bottom of waste-moving equipment buckets and blades and avoiding use of track-type equipment that produce high mechanical noise also limits noise. These approaches, however, can affect the transfer system's operational efficiency. Regardless of which approaches are employed, transfer station employees exposed to high levels of noise for prolonged periods of time should use earplugs or other protective devices to guard against hearing damage.

Air Quality

Tipping areas often have localized air quality problems (dust and odor) that constitute a safety and health hazard. Dust in particular can be troublesome, especially where dusty, dry commercial loads (e.g., C&D wastes) are tipped. Prolonged exposure to air emissions from waste and motorized vehicles operating inside the building provides another potential health threat to facility employees. Facility air quality issues can be addressed through a number of design and operational practices. These include:

- Water-based dust suppression (misting or spray) systems used to "knock down" dust. Different types of systems are available. They typically involve a piping system with an array of nozzles aimed to deliver a fine spray to the area where dust is likely to be generated (e.g., over the surge pit). They typically are actuated by station staff "on demand" when dust is generated. Dust suppression systems can operate using water only or can have an injection system that mixes odor-neutralizing compounds (usually naturally occurring organic extracts) with the water. These dual purpose systems effectively control both dust and odors. Water-based dust suppression systems, however, can have adverse economic impacts. The additional moisture added to the waste increases the weight of outbound loads, potentially reducing truck capacity and increasing costs.

- Use of handheld hoses to wet down the waste where it is being moved or processed, typically in a pit. Designers need to consider using convenient reel-mount hoses for this purpose.
- Ventilation systems can control air quality inside enclosed transfer buildings. While the high roofs and large floor areas common in transfer stations put unique demands upon ventilation systems, it is still possible through engineering techniques to create the air velocities needed to entrain dust particles. One approach is to concentrate system fans and air removal equipment above the dustiest and most odor-prone area to create a positive air flow from cleaner areas. Often, the air-handling equipment is designed with multiple speed fans and separate fan units that can be activated during high dust or odor events. Filtering and scrubbing exhaust air from transfer stations is also possible.
- If employees' direct exposure to harmful emissions from vehicles and waste at the facility is not sufficiently minimized, respiratory aids such as masks might be necessary.

Hazardous Wastes and Materials

While MSW is generally nonhazardous, some potentially hazardous materials such as pesticides, bleach, and solvents could be delivered to a transfer station. Facility operators should ensure that employees are properly trained to identify and handle such materials. Some stations have a separate household hazardous waste (HHW) receiving and handling area. If the transfer station operates a program that manages HHW, the material is often collected by appointment only, during designated hours, or during special single or multiple day events.

All transfer stations need to be equipped to handle the occasional occurrence of hazardous waste, real or suspected, mixed with other wastes. Personal protective equipment such as goggles, gloves, body suits, and respirators should be on hand and easily accessible to employees. Because staff or customers might inadvertently come in contact with a hazardous substance, it is also good practice, and often required by code, to have special eyewash and shower units in the operating areas. Typically, the transfer station's operating plan will outline detailed procedures to guide station personnel in identifying and managing these kinds of wastes. Many stations have a secure area with primary and secondary containment barriers near the main tipping area where suspect wastes can be placed pending evaluation and analysis. Public education efforts can reduce the likelihood of hazardous materials showing up in solid waste.

Ergonomics

Improper body position, repetitive motion, and repeated or continuous exertion of force contribute to injuries. Both employers and employees should receive ergonomics training to reduce the likelihood of injury. Such training provides guidance on minimizing repetitive motions and heavy lifting and using proper body positions to perform tasks. At this time there are no federal ergonomic standards. A few states, however, do have such standards under their job safety and health programs. The Occupational Safety and Health Administration's Web site <www.osha-slc.gov/fso/osp/> includes a list of states with such programs and provides links to a number of these states' Web sites.

Facility Oversight

This section describes the types of regulations that generally apply to transfer stations and addresses typical regulatory compliance methods.

Applicable Regulations

Transfer stations are affected by a variety of federal, state, tribal, and local regulations, including those related to noise, traffic impact mitigation, land use, workplace safety, taxes, employee right-to-know, and equal employment opportunity that are applicable to any other business or public operation. Many jurisdictions also have regulations specifically applicable to transfer stations. These regulations typically emphasize the protection of public health and the environment.

Federal Regulations

No federal regulations exist that are specifically applicable to transfer stations. EPA, however, initiated a rulemaking process exclusively for marine waste transfer stations under authority of the Shore Protection Act in 1994. These rules would regulate vessels and marine transfer stations in the U.S. coastal waters. EPA is currently working with the U.S. Coast Guard on finalizing these rules.

State Regulations

State solid waste regulatory programs usually take primacy in transfer station permitting, although local zoning and land use requirements apply as well. State regulations vary widely. Some have no regulations specific to transfer stations; others mention them as a minor part of regulations that generally apply to solid waste management; and others have regulations specifically addressing transfer station issues such as design standards, operating standards, and the maximum amount of time that waste can be left on site. A few states also require transfer stations to have closure plans and to demonstrate financial assurance, while others require certification of key personnel. Some states also require compliance with regional solid waste planning efforts or demonstrations of "need."

Appendix A provides a state-by-state checklist of major transfer station regulatory issues. Appendix A shows that:

- All but five states require waste transfer stations to have some type of permit, permit-by-rule, or state license to operate.
- All 50 states have at least minimal operating standards for waste transfer stations either through regulations, statutes, operating plans, or construction permits.
- Some states require analysis of transfer station impacts under general environmental review procedures.

Local Regulations

Local regulation of transfer stations can take many forms. Typical regulatory bodies include counties, cities, regional solid waste manage-

The New Mexico Environment Department

hereby issues this

SOLID WASTE FACILITY PERMIT

Facility Type: Transfer Station and Recycling Facility

Facility ID No: SWM-071307

Facility Name & Location:
ACME Solid Waste
Transfer & Recycling
Albuquerque, NM

Owner's Name & Address:
ACME Solid Waste Authority
180 Yosemite Lane
Albuquerque, New Mexico 88001

Permit Expiration Date: November 2, 2015

This permit is issued pursuant to Section 74-9-20 of the Solid Waste Act and is subject to the conditions of the Order of the Secretary, dated November 2, 19 95.

Given this 14 day of November, 1995.

John Q. Doe
Secretary of Environment

Example of a state issued transfer station facility permit.

ment authorities, health departments, and air pollution control authorities.

Counties, cities, and regional authorities often are required to prepare comprehensive solid waste management plans describing long-range plans for waste prevention, recycling, collection, processing (including transfer stations), and disposal. Other local regulations likely to apply to transfer stations include zoning ordinances, noise ordinances, and traffic impact analysis.

Public health departments are involved with transfer stations because of the potential health concerns if solid waste is improperly managed. In some states, the state environmental protection agency delegates authority to local health departments to oversee solid waste management facilities, including transfer stations. This typically includes overseeing general compliance with a facility's operating permit; regular cleaning of the tipping floor; limits on the amount of waste the facility can accept; and employment of adequate measures to prevent vectors such as rats, birds, and flies from contacting waste.

Local or regional air pollution control authorities often regulate odor, dust, and vehicle exhaust emissions at transfer stations. Air pollution control agencies might regulate chemicals used to control odor, exhaust from vents on the facility's roof or walls, and whether dusty loads can be delivered to the transfer station. The local sanitary district often establishes waste water standards and might be involved in storm water management and protection.

Common Regulatory Compliance Methods

Compliance Inspections

Many transfer stations are inspected periodically for compliance with the transfer station's operating permit and other applicable regulations. The entity responsible for performing inspections and the frequency and level of detail of inspections vary widely around the country. Some inspections are complaint driven, some occur on a regular frequency, and some occur on a random basis. A typical inspection involves a representative of the local health department or state or tribal solid waste regulatory program walking through the facility, looking for improper waste storage or handling methods and writing up a short notice of compliance or noncompliance.

Other inspections for specific issues are also conducted. Special inspections might target workplace safety, proper storm-water runoff management, and compliance with applicable roadway weight limits for transport vehicles.

Reporting

Some transfer station operators are required to compile monthly, quarterly, or annual reports for submission to regulatory agencies and host communities. These reports typically include the following information:

- Weight (tons) and loads (number of customers) received at the transfer station each month. This sometimes includes details such as day of the week, time of day, type of waste, name of hauler, and origin of waste.
- Weight (tons) and loads (number of transfer truck shipments) shipped from the transfer station each month. This sometimes includes a breakdown by time shipped, type of waste, and the final destination of the waste.
- A description of any unusual events that took place at the transfer station, including accidents and discoveries of unacceptable waste.
- A summary of complaints received and the actions taken to respond to the complaints.

Resources

Leon County, Florida. *Leon County Solid Waste Transfer Station: Noise Study Report.* February 2000 (Draft).

Lund, Herbert F. 1992. *Solid Waste Handbook.* McGraw-Hill Companies.

National Environmental Justice Advisory Council. 2000. *A Regulatory Strategy for Siting and Operating Waste Transfer Stations,* (EPA500-R-00-001). Washington, DC.

Solid Waste Association of North America. 2000. *Certification Course Manual: Managing Transfer Station Systems.* SWANA. Washington, DC.

Tchobauoglous, George, Hilary Theisen, and Samuel A. Vigil. 1993. *Integrated Solid Waste Management: Engineering Principles and Management Issues.* McGraw-Hill Companies.

U.S. EPA, Office of Solid Waste and Emergency Response. 2000. *Waster Transfer Stations: Involved Citizens Make the Difference,* (EPA530-K-01-003). Washington, DC.

U.S. EPA, Office of Solid Waste and Emergency Response. 1995. *Decision-Maker's Guide to Solid Waste Management,* Second Edition (EPA 530-R-95-023). Washington, DC.

DuPage County Solid Waste Department. 1998. *Solid Waste Transfer in Illinois: A Citizen's Handbook on Planning, Siting and Technology*. Weaver Boos & Gordon, Inc. (For information on ordering copies of the DuPage County publication entitled *Solid Waste Transfer in Illinois: A Citizen's Handbook on Planning, Siting and Technology* contact Kevin T. Dixon, Director, Solid Waste Department, DuPage County Center, 421 N. Country Farm Road, Wheaton, Illinois 60187, telephone (630)682-7373.)

Glossary of Terms and Acronyms

Baler: This technology compresses waste into high-density, self-contained units (bales) of either waste or recyclables. Baled waste is transported on flatbed trailers (as opposed to transfer trailers) and is most often sent to a "balefill" that has special equipment (e.g., forklifts).

Buffer zone (also setback): The distance between the transfer station or roadways and adjacent properties; often used for screening.

Collection vehicle: Residential collection vehicles include front-loading and rear-loading garbage trucks, as well as special trucks with compartments used to pickup source-separated recyclables. Commercial (businesses), institutional (hospitals and schools), and industrial (plants) waste, as well as C&D waste, is often discarded in rolloff boxes, which are dropped at the facility and then collected on schedule.

Construction and demolition debris (C&D): Includes broken concrete, wood waste, asphalt, rubble. This material can often be separated for beneficial use.

Convenience center (also citizen's dropoff or green box): Small transfer facilities used in low-volume or rural settings. These low-technology options often use rolloff boxes with an inclined ramp for cars and pickups. Bins can be included for recyclables that are source-separated.

Direct haul: The historic practice of sending collection vehicles (mostly garbage trucks) directly to the landfill without using transfer stations. When landfills were close to the waste sources, a residential collection vehicle customarily made two trips per day to the landfill.

Host community benefits: A transfer station or landfill operator can offer specific benefits to the community selected for a proposed facility. The benefits are listed in a Host Community Agreement. Benefits can include cash, free tipping, highway improvements, and tax reductions.

Household hazardous wastes (HHW): HHW come from residences, are generally produced in small quantities, and consist of common household discards such as paints, solvents, herbicides, pesticides, and batteries.

Loadout: The process of loading outbound transfer trailers with waste; or loading trucks with recyclables destined for the market.

Municipal solid waste (MSW): Generally defined as discards routinely collected from homes, businesses, and institutions, and the nonhazardous discards from industries.

Queuing distance: The space provided for incoming trucks to wait in line.

Source-separated: Recyclables discarded and collected in containers separate from non-recyclable waste. Bins or blue bags are used to separate residential recyclables; separate boxes or containers are used for commercial/industrial discards (e.g., corrugated cardboard packaging, wood pallets). Source-separated wastes usually are delivered to a material recovery facility.

Surge pit: A pit usually made of concrete that receives waste from the tipping floor. Surge pits provide more space for temporary storage at peak times and allow for additional compaction of waste before loadout.

Tipping fee: The unit price charged at the disposal site or transfer station to accept waste, usually expressed as dollars per ton or dollars per cubic yard.

Tipping floor: The floor of the transfer station where waste is unloaded (tipped) for inspection, sorting, and loading.

Tons per day (TPD): The most common unit of measurement for waste generation, transfer, and disposal. Accurate TPD measurements require a scale; conversion from "cubic yards" without a scale involves estimated density factors.

Walking floor: A technology built in to lightweight transfer trailers and used to unload waste at the disposal site. Moving panels "walk" the waste out of the trailer bed.

Waste diversion: The process of separating certain materials at the transfer station to avoid the cost of hauling and the tipping fee at the landfill.

Waste screening: Inspecting incoming wastes to preclude transport of hazardous wastes, dangerous substances, or materials that are incompatible with transfer station or landfill operations.

Appendix A: State Transfer Station Regulations

The table starting on page A-2 is designed to serve as a quick reference guide and comparative index of all state transfer station regulations. Almost all of these regulations are available over the Internet, and the URLs are provided at the end of this section.

Permit Requirements. Nearly all states require transfer facilities to obtain a permit before beginning operations. The vast majority of states issue standard permits after a transfer station's application has been reviewed and approved. A few states have permit-by-rule provisions, which allow transfer stations to forego the application process by demonstrating compliance with a set of designated standards. Of the states not requiring permits for transfer stations, about half require the facility to register with the state prior to beginning operation.

Siting Requirements. Siting requirements refer to any additional regulatory requirements beyond relevant and applicable state or local zoning requirements or conditions. Siting requirements could include prohibitions against siting in or near wetlands, flood plains, endangered species habitats, airports, or other protected sites.

Design Standards. Nearly all states have at least minimal design criteria for transfer stations. These requirements typically set standards for waste receiving areas and waste-storage areas that include building structural features, access control, vector control, and dust and odor controls.

Operational Standards. These standards establish how the transfer station will be run and how wastes will be handled. Standards often include hours of operation, safety issues, litter control, dust and odor control, disease vector control, facility cleaning/sanitation practices, waste removal, traffic control, and contingencies.

Operator Certification. Only five states have mandatory operator certification for transfer station operators (Arkansas, New Hampshire, New Mexico, New York, and Ohio). Other state regulations stipulate that a transfer station operator must be a "qualified solid waste manager" but do not have requirements for any specific type of certification.

Storage Restrictions. Many states have established time limits on how long waste may remain in a transfer station. Storage time restrictions vary from state to state, and sometimes even within a state, depending upon the size of the transfer station.

Recordkeeping Requirements. The majority of states require a transfer station to maintain onsite records of all incoming and outgoing waste as well as copies of the facility permit, operating plan, contingency plan, and proof of financial assurance, when such things are applicable.

Reporting Requirements. Many states require transfer stations to submit reports at least annually to the state environmental agency. These reports often include information such as the name and location of the transfer station, the amounts and types of waste accepted, and the source and final destination of this waste.

Monitoring Requirements. Monitoring refers to any surface water, soil, or air compliance monitoring that a transfer station may be required to perform by its state.

Closure Requirements. Closure requirements include standards or timetables for removing wastes and cleaning the transfer station site after the facility stops receiving waste and permanently ends operations. Most states with closure requirements require transfer stations to remove all wastes and close the facility in a manner that eliminates any threats to human health and the environment and minimizes the need for further maintenance.

Financial Assurance Requirements. Some states require transfer stations to demonstrate that they have sufficient funds to properly close the facility when it ceases operation. Financial assurance mechanisms often include trust funds, insurance policies, letters of credit, or other financial tests.

State Transfer Station Regulations

State	Regulation	Permit Requirements	Siting Requirements	Design Standards	Operational Standards	Operator Certification
Alabama	Chapter 420-3-5-.12	Yes	Yes	Yes	Yes	No
Alaska	18 AAC 60	No	No	No	Yes	No
Arizona	None[1]	No - But must self-certify or notify state[2]	No	No	Yes	No
Arkansas	Reg. 22, Chapter 9	Yes	Yes	Yes	Yes	Yes
California	Title 14 Article 6	Yes	No	Yes	Yes	No
Colorado	6 CCR 1007-2	No[4]	No	Yes	Yes	No
Connecticut	22a-209 RCSA	Yes	Yes	No	Yes	Yes
Delaware	Delaware S.W. Regs., Section 10	Yes	Yes	Yes	Yes	No
Florida	Rule 62-701-FAC	Yes	Yes	Yes	Yes	No
Georgia	Chapter 391-3-4	Yes - Permit-by-rule, must notify state	No	No	Yes	No
Hawaii	Title II, Chapt. 58.1	Yes	No	Yes	Yes	No
Idaho (current rules	IDAPA 58.01.06	Yes - Conditional use permit	No	No	Yes	No
Idaho (proposed rule)[5]	IDAPA 16	Yes	Yes	Yes	Yes	No
Illinois	IAC Title 35, Subtitle G, Chapter I, Subchapter I, Part 807, Subparts A&B	Yes	No	No (Yes)[6]	No (Yes)	No
Indiana	329 IAC 11	Yes	No	No	Yes	No
Iowa	IAC 567 Chapter 100	Yes	No	Yes	Yes	No
Kansas	KAR 28-29	Yes	Yes	Yes	Yes	No

Storage Restrictions	Recordkeeping Requirements	Reporting Requirements	Monitoring Requirements	Closure Requirements	Financial Assurance Requirements
Yes - 24 hours	Yes	No	No	Yes	No
No	No	No	No	No	No
No	No	No	No	No	No
Yes - No extended storage of putrescibles	Yes	Yes - Periodic	No	No	Yes - At state discretion
Yes - 48 hours for facilities; within 7 days for operations[3]	Yes	Yes - Quarterly	Possible - As part of nuisance control measures	Yes	No
Yes - No overnight storage on tipping floor	Yes	No	No	Yes	No
Yes - 48 hours	Yes	Yes	No	No	No
Yes - 72 hours, all overnight storage in enclosures	Yes	Yes	Possible - State may require post-closure monitoring	Yes	Yes
No	Yes	No	No	No	No
No	No	No	No	Yes	No
No	Yes	Yes - Annual, by June 30	No	Yes	No
No	Yes	No	No	No	No
No	Yes	No	No	Yes	No
No (Yes)	No (Yes)	No (Yes)	No	Yes	No
Yes - Remove next day (except on weekends and holidays)	Yes	Yes - Annual, by January 31 and quarterly tonnage reports	No	Yes	Yes
Yes - 72 hours	No	No	No	Yes	No
Yes - Loaded into transfer vehicle next day	Yes	Yes - Annual, by March 1	Possible - At state's discretion	Yes	Yes

State	Regulation	Permit Requirements	Siting Requirements	Design Standards	Operational Standards	Operator Certification
Kentucky	401 KAR 47	Yes - Registered permit-by-rule	Yes	No	Yes	No
Louisiana	LAC 33: VII Subpart I	Yes	Yes	Yes	Yes	No
Maine	ME SW Mgt. Rules Chapter 402	Yes	Yes	Yes	Yes	No
Maryland	Title 26 Chapter 07	Yes	No	Yes	Yes	No
Massachusetts	310 CMR 16.00 & 19.00	Yes	Yes	Yes	Yes	No
Michigan	MAC R299, Part 5	Yes	Yes	Yes	Yes	No
Minnesota	Chapter 7035	Yes	Yes	Yes	Yes	No
Mississippi	Section V	Yes	Yes	Yes	Yes	No
Missouri	10 CSR 80-5	Yes	Yes	Yes	Yes	No
Montana	ARM Title 17 Chapter 50, Sub-Chapters 4 and 5	Yes	Yes	Yes	Yes	No
Nebraska	Title 132	Yes	Yes	Yes	Yes	No
Nevada	NAC 444.666	No[7]	No	Yes	Yes	No
New Hampshire	NHCAR Env-Wm Chapters 314 & 2100 RSA 149M	Yes	Yes	Yes	Yes	Yes
New Jersey	NJAC 7:26	Yes	Yes - Must perform an EHIS	Yes	Yes	No
New Mexico	20 NMAC 9.1	Yes	No	No	Yes	Yes
New York	6 NYCRR Part 360	Yes	Yes	Yes	Yes	Yes
North Carolina	NCAC Title 15A, Subchapter 13B	Yes	No	No	Yes	No

Storage Restrictions	Recordkeeping Requirements	Reporting Requirements	Monitoring Requirements	Closure Requirements	Financial Assurance Requirements
No	Yes	No	No	No	No
No	Yes	Yes - Annual, by August 1	No	Yes	Yes
No	Yes	Yes - Annual, by October 31	Possible - At state's discretion	Yes	Yes
Yes - No overnight storage, unless in containers	No	Yes - Annual	No	No	No
Yes - no accumulation of odor-causing wastes	Yes	No	No	Yes	Possible - At state's discretion
Yes - No overnight, unless in closed containers	No	No	No	No	No
Yes - 1 week if in leak-and vector-proof container or enclosure	Yes	Yes - Annual, by February 1	Possible - At state's discretion	Yes	No
Yes - Waste removed at least once per week	Yes	No	No	No	No
Yes - No putrescibles longer than 24 hours	Yes	No	No	No	Yes
Yes - waste containers emptied at least once a week	No	Yes - Annual, by April 1	No	No	No
No	Yes	No	No	Yes	Yes
Yes - 72 hours after acceptance	Yes	No	No	Yes	No
Yes - Remove putrescibles within 1 week or before producing an odor	Yes	Yes - Annual, by March 31	No	Yes	Yes
Yes - No overnight storage	Yes	Yes - Monthly	No	No	No
Yes - <250 $yards^3$, every other day; >250 $yards^3$, no overnight storage	Yes	Yes - Annual, within 45 days of end of calendar year	No - But must demonstrate groundwater will be protected	Yes	Yes
Yes - When all containers full or 7 days	Yes	Yes	Yes	Yes	Possible - At state's discretion
No	No	No	Possible - At state's discretion	No	No

State	Regulation	Permit Requirements	Siting Requirements	Design Standards	Operational Standards	Operator Certification
North Dakota	Article 33-20	Yes	Yes	Yes	Yes	No
Ohio	3745-27-(15, 21-24)	Yes	Yes	Yes	Yes	Yes
Oklahoma	OAC 252:520	Yes	Yes	No	Yes	No
Oregon	OAR Chapter 340, Division 96	Yes	No	Yes	Yes	No
Pennsylvania	25 PA Code Chapt. 271, 279	Yes	Yes	Possible - at state's discretion	Yes	No
Rhode Island	Solid Waste Regulation No.1 & No.3	Yes	Yes	Yes	Yes	No
South Carolina	Chapter 61, Part 8 (61-107.7)	Yes	Yes	Yes	Yes	No
South Dakota	Article 74:27	Yes	No	Yes	Yes	No
Tennessee	Chapter 1200- 1-7	Possible[8] - Permit-by-rule	Yes	Yes	Yes	No
Texas	30 TAC, Chapter 330	Yes	Yes	Yes	Yes	No
Utah	R315-313	No[9]	No	Yes	Yes	No
Vermont	Chapter 6	Yes	Yes	Yes	Yes	No
Virginia	Title 9 VAC 20-8-340	Yes - Permit-by-rule	Yes	Yes	Yes	No
Washington	WAC 173-304	Yes	No	Yes	Yes	No
West Virginia	33 CSR 1	Yes	Yes	Yes	Yes	No
Wisconsin	NR 502.07	Yes	Yes	Yes	Yes	No
Wyoming	3292 Chapter 6	Yes	Yes	Yes	Yes	No

Storage Restrictions	Recordkeeping Requirements	Reporting Requirements	Monitoring Requirements	Closure Requirements	Financial Assurance Requirements
No	Yes	Yes	No	Yes	No
Yes - Must be in covered container or building if stored longer than 12 hours	Yes	Yes - Annual, by April 1	Possible - At state's discretion	Yes	Yes
Yes - 24 hours (48 hours with vector/odor controls)	Yes	Yes - Monthly, by the 10th of each month	No	Yes	Yes
No	Possible - At state's discretion	Possible - At state's discretion	No	No	No
Yes - 24 hours (up to 72 over weekend)	Yes	Yes - Annual, by June 30	Possible - At state's discretion	Yes	Yes
Yes - Remove combustible SW within 48 hours	No	No	No	Yes	Yes - Though state may wave if decides unnecessary
Yes - Remove putrescibles w/in 24 hours	Yes	No	Possible - At state's discretion	Yes	No
No	Yes	No	No	Yes	No
No	Yes	No	No	Yes	Yes - If facility has storage capacity of 1000 yds^3 or greater
No	Yes	No	No	Yes	Possible
Yes - 7 days	Yes	Yes - Annual, by March 1	No	Yes	No
Yes - Remove waste from tipping floor by end of operating day	Yes	Yes - Quarterly	No	Yes	Yes
Yes - Remove waste at end of work day	No	No	No	Yes	Yes
No	Yes	Yes - Annual, by March 1	No	Yes	No
Yes - Remove waste at end of day/not more than 24 hours	Yes	Yes - Monthly tonnage reports; and annual by January 31	No	Yes	Yes
Yes - 24 hours (with some exceptions)	No	No	Possible - At state's discretion	Yes	Possible - At state's discretion
No	Yes	No	Possible - At state's discretion	Yes	Yes

Notes

1. Arizona currently does not have regulations governing waste transfer stations, but the Arizona Revised Statutes (ARS) have requirements that govern these facilities. The information in this matrix reflects these statutory requirements found at ARS 49-762.
2. In Arizona transfer stations that receive greater than 180 cubic yards/day must self-certify and demonstrate that the facility is in compliance with state rules. Transfer stations receiving less than 180 cubic yards/day must notify the state prior to commencement of operations and operate in accordance with state BMPs.
3. California classifies a transfer station as a facility if it receives greater than 60 cubic yards or 15 tons of waste per day or as an operation if it receives less than 60 cubic yards or 15 tons of waste per day.
4. While Colorado does not require a permit for transfer stations, the local governing body (county or municipal government) may.
5. Idaho has proposed a three-tiered system based upon the type of waste handled at a facility. This matrix assumes a solid waste transfer station would be considered a Tier II facility.
6. Illinois does not have explicit design, operating, storage, recordkeeping, or reporting requirements in its regulations. The state establishes these standards for each facility by requiring a facility to demonstrate in its permit application that it will meet specific standards. The Illinois regulations require a facility to provide to the state all the information requested in its permit application and once the permit is approved to comply with the terms of its permit.
7. While no permit is required in Nevada, a facility must submit and have approved by the state an application to build or modify a transfer station prior to any action being taken.
8. In Tennessee transfer stations that compact or otherwise process waste are considered "processing facilities" and are subject to the permit-by-rule requirements. If no processing occurs at a transfer station, then the facility is not subject to permitting. Tennessee currently has rule amendments under review which would make all transfer stations subject to the permit-by-rule standards. The responses in this appendix apply to permit-by-rule facilities.
9. While Utah does not require a transfer station to obtain a permit, it does require a transfer station to get a plan approval. In a plan approval, the operator states how the facility will meet the transfer station guidelines found in the solid waste regulations.

Transfer Stations: State Regulations URLs (as of 11/30/2001)

Alabama: <www.adem.state.al.us/RegsPermit/ADEMRegs/rules.html> Note: Chapter 420-3-5: Solid Waste Collection and Transportation Rules contain regulations governing transfer stations but are not available on Alabama Public Health Web site <www.alapubhealth.org/>.

Alaska: <www.state.ak.us/local/akpages/ENV.CONSERV/title18/title18.htm>

Arizona: Arizona Administrative Code <www.sosaz.com/public_services/Table_of_Contents.htm>. Applicable statutes are located at <www.azleg.state.az.us/ars/49/title49.htm>.

Arkansas: <www.adeq.state.ar.us/ftproot/Pub/regs/reg22.pdf>

California: <www.ciwmb.ca.gov/Law.htm>

Colorado: <www.cdphe.state.co.us/regulate.asp>

Connecticut: Regulations are not yet available on the Internet (as of 12/3/01).

Delaware: <www.dnrec.state.de.us/dnrec2000/Divisions/AWM/hw/sw/swreg.htm>

Florida: <www.dep.state.fl.us/waste/categories/solid_waste/default.htm>

Georgia: <www.ganet.org/dnr/environ/>

Hawaii: <www.state.hi.us/health/eh/shwb/sw/index.html>

Idaho: <www2.state.id.us/adm/adminrules/rules/IDAPA58/58INDEX.HTM> — Idaho has proposed new solid waste management rules, which will include additional requirements for transfer stations. See <www2.state.id.us/adm/adminrules/bulletin/99index.htm> - Select Bulletin 99-8, Vol. 1.

Illinois: <www.ipcb.state.il.us/Title_35/main.htm>

Indiana: <www.in.gov/legislative/iac/title329.html>

Iowa: <www.legis.state.ia.us/IAC.html>

Kansas: <www.kdhe.state.ks.us/waste/bwm_download_page.html>

Kentucky: <www.nr.state.ky.us/nrepc/dep/waste/regs/regulati.htm>

Louisiana: <www.deq.state.la.us/planning/regs/title33/index.htm>

Maine: <www.state.me.us/sos/cec/rcn/apa/06/chaps06.htm>

Maryland: <www.mde.state.md.us/comar.html>

Massachusetts: <www.magnet.state.ma.us/dep/matrix.htm>

Michigan: <www.deq.state.mi.us/wmd/SWP/sw_r&s.htm>

Minnesota: <www.pca.state.mn.us/rulesregs/index.html>

Mississippi: <www.deq.state.ms.us/newweb/homepages.nsf> Look under Office of Pollution Control.

Missouri: <mosl.sos.state.mo.us/csr/10csr.htm>

Montana: <www.deq.state.mt.us/dir/legal/title17.asp>

Nebraska: <www.deq.state.ne.us/RuleandR.nsf/Pages/Rules>

Nevada: <ndep.state.nv.us/admin/nrs.htm>

New Hampshire: <www.des.state.nh.us/desadmin.htm>

New Jersey: <www.state.nj.us/dep/dshw/resource/rules.htm>

New Mexico: <ftp://www.nmenv.state.nm.us/regulations/20nmac9_1.txt>

New York: <www.dec.state.ny.us/website/regs/index.html>

North Carolina: <wastenot.ehnr.state.nc.us/swhome/rule.htm>

North Dakota: <www.health.state.nd.us/ndhd/environ/wm/>

Ohio: <www.epa.state.oh.us/dsiwm/pages/currentrule.html>

Oklahoma: <www.deq.state.ok.us/rules/rulesindex.htm>

Oregon: <arcweb.sos.state.or.us/rules/OARS_300/OAR_340/340_tofc.html>

Pennsylvania: <www.pacode.com/>

Rhode Island: <www.state.ri.us/dem/pubs/regs/index.htm>

South Carolina: <www.lpitr.state.sc.us/coderegs/statmast.htm>

South Dakota: <legis.state.sd.us/rules/index.cfm>

Tennessee: <www.state.tn.us/sos/rules/1200/1200-01/1200-01.htm>

Texas: <www.tnrcc.state.tx.us/oprd/rules/indxpdf.html>

Utah: <www.deq.state.ut.us/EQSHW/swrules.htm>

Vermont: <www.anr.state.vt.us/dec/rules/rulessum.htm>

Virginia: <www.deq.state.va.us/waste/wasteregs.html>

Washington: <access.wa.gov/government/awlaws.asp>

West Virginia: <www.wvsos.com/csr/>

Wisconsin: <www.legis.state.wi.us/rsb/code/>

Wyoming: <soswy.state.wy.us/cgi-win/sscgi_1.exe>

United States Environmental Protection Agency
Solid Waste and Emergency Response (5306W)
EPA530-R-02-002
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