BENEFICIAL REUSE OF FOUNDRY SAND:
A REVIEW OF STATE PRACTICES AND REGULATIONS

Sector Strategies Division
Office of Policy, Economics, and Innovation
U.S. Environmental Protection Agency
Washington, DC

In partnership with
American Foundry Society
Association of State and Territorial Solid Waste Management Officials

December 2002

The U.S. EPA's Sector Strategies Division, Office of Policy, Economics, and Innovation, would like to acknowledge the many people who contributed to this document. Industrial Economics, Inc. was EPA's principal contractor and main author. The American Foundry Society (AFS) and Association of State and Territorial Solid Waste Management Officials (ASTSWMO) were EPA's partners in this project. Their members provided ideas for structure and content for the report, and they offered valuable suggestions for improving earlier drafts. The assistance provided by Elizabeth Olenbush of Foundry Industry Recycling Starts Today (FIRST) and Dale Thompson of the Minnesota Pollution Control Agency were especially helpful. Amy Blankenbiller of Waterman and Associates provided crucial input on sources for content and acted as liaison between EPA and the foundry industry. EPA's Office of Solid Waste as well as the U.S. Departments of Transportation and Agriculture also assisted in preparation of the document.

For further information regarding this primer and EPA's partnership with the metal casting sector, please contact Jerry Newsome (202-566-2967, *newsome.jerry@epa.gov)* or Peter Truitt (202-566-2970, *truitt.peter@epa.gov)* at the U.S. EPA, or Amy Blankenbiller (202-828-1444, *ab@wafed.com)* representing the industry.

TABLE OF CONTENTS

1.0 BACKGROUND

Every year foundries generate between nine and 13 million tons of sand that is unfit for continued use in the mold-making process. Only a small percentage of this used foundry sand is characterized as hazardous waste, with the overwhelming majority qualifying as non-hazardous industrial waste. Although some sand is currently "beneficially reused" – industry experts estimate that approximately one million tons is beneficially reused outside of the foundry – foundries typically discard this material in municipal or private landfills.[1] Given the potential for reusing a substantial amount of the non-hazardous sand in a variety of ways, including roadbeds, construction fill, and cement, it is likely that much of the sand currently disposed of in landfills is "beneficially reusable."

A variety of factors contribute to the low level of sand reuse. These factors affect each of the stakeholders who can play a role in beneficially reusing this waste.

- For states, developing a regulatory structure that simultaneously ensures environmental protection and encourages appropriate beneficial reuse can be very challenging. Also, the lack of an established process for evaluating and permitting reuses can be a significant barrier.

- Prospective end users may not know that foundry sand is reusable. They may incorrectly assume that foundry sand may not perform properly from an engineering standpoint, or that it may contain unacceptable concentrations of toxic constituents.

- Finally, foundries may not be aware of the many potential uses for their sand, or may not have considered simple operational changes that could have dramatic effects on the characteristics of sand (e.g., waste stream segregation) and thus enhance their ability to find alternatives to landfill disposal.

[1] Foundry sand estimates are from Dr. Paul J. Tikalsky of Pennsylvania State University, collated from FIRST (Foundry Industry Recycling Starts Today) data.

1.1 PURPOSE OF THIS REPORT

The foundry industry has frequently cited the beneficial reuse of foundry sand as one of its most important environmental issues. To address this concern, the U.S. Environmental Protection Agency (EPA) assembled a workgroup of representatives from industry, states (the Association of State and Territorial Solid Waste Management Officials, ASTSWMO), and the U.S. Departments of Transportation and Agriculture. The workgroup recommended that EPA research existing state beneficial reuse programs, conduct case studies examining "real-world" reuses of foundry sand, conduct a scientific characterization of foundry sands, and suggest approaches to encourage increased future reuse.

In response to the workgroup's recommendations, EPA researched regulations, statutes, guidance documents, policies, websites, and other publicly available information regarding beneficial reuse of foundry sand, industrial waste recycling, and solid waste designation in 18 states. These states have the largest numbers of foundries in the country and have active industrial waste recycling programs or initiatives. EPA also conducted four case studies of ongoing or recently completed projects involving the beneficial reuse of sand.

Additional testing data are needed to more fully characterize the composition of foundry sand, and tests are being conducted. In the interim, this report is intended to serve as a national reference for all stakeholders potentially involved in the beneficial reuse of foundry sand.

- **For states**, the document provides regulators with information to facilitate the process of determining appropriate beneficial reuses. It is a resource for understanding existing guidance and/or regulations developed by other states, which can serve as a model for developing beneficial reuse policy.

- **For foundries**, it is a resource for: (1) understanding existing guidance and/or regulations developed by different states; and (2) identifying reuses that are alternatives to sand disposal and working with states to take advantage of them.

- **For potential end users**, the document is a resource for exploring the potential use of foundry sand as an alternative to virgin raw materials.

This report was prepared by the Metal Casting Industry Performance Partnership Program, created and led by the Sector Strategies Division within EPA's Office of Policy, Economics, and Innovation. The program is a cooperative effort involving EPA, the American Foundry Society, and a number of state governments. It aims to reduce pollution and increase the reuse and recycling of used materials in the metal casting sector, including foundries.

1.2 SUMMARY OF KEY FINDINGS

EPA's research on state programs and insights gained from case studies highlight several key findings related to sand reuse. When considered together, these findings suggest that there is significant opportunity for expanding beneficial reuse of foundry sand:

- **Used foundry sand is a high volume industrial waste that can be more widely reused as an alternative to landfill disposal.** A brief look at three factors supports this finding: (1) foundries generate substantial volumes of used sand that is non-hazardous, consistent in composition, and available in ample supply; (2) foundry sand exhibits physical and engineering characteristics comparable to those of virgin raw materials used in a variety of applications, such as asphalt manufacturing, road embankment construction, and soil amendments (see Exhibit 1-1 for a list of potential beneficial reuses); and (3) landfill capacity should not be used for materials that can be beneficially reused.

- **Many states are receptive to recycling/reuse proposals from industry, provided they are backed by sound science demonstrating that reuse will not result in adverse environmental impacts.** The quantity and quality of testing and scientific data provided to the state in support of reuse proposals are critical factors affecting the state's ability to develop protective beneficial reuse permits, policies, and regulations. Because developing the necessary data to support a new reuse can be extremely burdensome for an individual foundry, efforts on the part of state agencies or trade associations to sponsor the necessary research can significantly contribute to the expansion of reuse opportunities.

- **Simple, straightforward regulations that streamline the process for approving reuses can enhance the opportunities for safe, beneficial reuse of foundry sand.** The key factor in increasing foundry sand reuse appears to be the strong support and encouragement of the state regulatory agency. This support can be seen in some states' efforts to streamline the approval process for reuse projects. States use a range of alternatives to simplify project approvals, including issuing general permits that cover multiple reuse projects, allowing certain reuse projects to proceed with only prior notification, and providing waste exemptions for qualifying by-products.

- **Cost savings is the primary motivating factor for reuse of foundry sand.** In determining whether to pursue opportunities to reuse sand, a foundry weighs the cost of transporting sand to a landfill and tipping fees against the costs of preparing sand for reuse, which may include segregating sand from other by-products, and transporting it to the reuse location. End users weigh the cost of virgin raw material against the cost of obtaining and using foundry sand, including testing that must be performed on end products, lead time required for project approval, and the effect on sales of a negative perception of products containing an industrial by-product.

Exhibit 1-1

BENEFICIAL REUSES OF FOUNDRY SAND

Foundry sand can be suitable for a variety of beneficial reuses. Terminology for defining uses varies across states. For the purposes of this report, EPA has developed definitions for common uses of sand in consultation with industry experts. The following are uses of foundry sand approved in one or more states:

Structural Fill

Foundry sand can be used as support for structures such as roadways, parking lots, buildings, and pieces of equipment. "Encapsulated" structural fill may involve the use of a liner, cap, or cover, generally made of a clay material, which prevents water from percolating through the foundry sand and minimizes the potential for leaching.

Manufacturing Another Product

Foundry sand is useful as a raw material in manufacturing other products, such as controlled, low-strength material (CLSM or flowable fill), asphalt, cement, concrete, grout, lightweight aggregate, concrete block, bricks, roofing materials, plastics, paint, glass, ceramics, and rockwool. Specific examples of these uses include:

- *Flowable fill*: Flowable fill is a liquid-like material that self-compacts and is used as a substitute for conventional soil backfill. The product is easily transported and can be readily re-excavated. The typical mixture contains sand, fly ash, portland cement, and water. Foundry sand can readily be substituted for virgin sand in flowable fill mixtures.

- *Cement and Concrete*: Sand is a component of Portland cement and concrete. Portland cement requires sand with a silica content of at least 80 percent, which most foundry sands meet. It also requires certain minerals such as iron and aluminum oxides, which are found in many foundry sands. Cement and additional sand or gravel are components of concrete, allowing further reuse of foundry sand.

Soil Manufacturing and Amendment

Commercial soil blending operations can use foundry sand to produce horticultural soils, topsoil, potting soil, and turf mixes. These soil products are typically mixtures of sand or gravel with peat, fertilizers, and/or top soil. Foundry sand can also improve the performance of agricultural soils, and can be used as a composting ingredient.

Landfill Uses

Foundry sand can be used as a cover for the working face of an active landfill, for road construction within the active cell, or as a substitute for virgin aggregate in the construction of drainage layers for landfill leachate collection systems.

Pipe Bedding and Backfill

Foundry sand can serve as backfill for trenches created by the installation of storm and sanitary sewer lines.

- **Foundry sand consolidators create economies of scale that can overcome some of the barriers to increased beneficial sand reuse.** In many cases, foundry sand reuses involving a single foundry or end user may not be economically or operationally feasible, particularly when transportation costs are prohibitively expensive or when individual foundries generate relatively small quantities of sand. "Middlemen" can make sand reuse possible through consolidating and preparing sand from multiple foundries for reuse by multiple end users.

- **Heightened awareness among stakeholders can substantially increase the volume of foundry sand beneficially reused.** Information sharing among federal, state, and local government agencies, foundries, and potential end users can: (1) increase both the supply of foundry sand available as a raw material and the demand for it as a substitute for virgin raw materials; (2) provide state regulators with more information about the characteristics of foundry sand, and with examples of how they can structure their programs to encourage increased sand reuse while protecting against any potential negative environmental impacts; (3) increase foundries' awareness of the opportunities for reuse; and (4) educate potential end users about the comparability of foundry sand to virgin raw materials as an input to their products.

1.3 ORGANIZATION OF REPORT

This report presents the results of EPA's research into state practices and regulations regarding the beneficial reuse of foundry sand. Chapter 2 provides a brief overview of the foundry industry and a description of the composition of foundry sand. Chapter 3 describes the range of approaches to regulating the reuse of non-hazardous industrial wastes across 18 states. (Appendix A provides additional information on industrial waste programs in these states.) Chapter 4 is a more in-depth review of the guidance and regulations developed by seven states that specifically address beneficial reuse of foundry sand in their guidance and/or regulations. EPA also conducted four case studies of ongoing or recently completed projects involving the beneficial reuse of sand to identify factors that affect the potential for sand reuse. Chapter 5 includes brief descriptions of each case study, plus an overview of the findings from the case studies. (More detailed descriptions of the case studies are included in Appendix B.)

2.0 THE FOUNDRY INDUSTRY

In 2000, the domestic foundry industry reported over 27 billion dollars in sales.[2] The industry produces castings for a wide array of products ranging from engine blocks to construction and farming equipment to golf club heads. Foundries typically utilize temporary molds constructed of sand and other materials, and are classified as either ferrous or non-ferrous, depending on the type of metals used. Ferrous foundries produce parts cast from iron and steel. Non-ferrous foundries may use aluminum, beryllium, cobalt, copper, zinc, lead, tin, nickel, magnesium, or titanium.

The majority of foundries are located close to their major markets, which are in large part the industrial/automobile manufacturing belt in the central United States. Foundries in six states – Ohio, Michigan, Illinois, Wisconsin, Pennsylvania, and California – make up over half of all foundries in the United States.[3]

2.1 SAND USE WITHIN FOUNDRIES

Foundries produce ferrous and non-ferrous castings, and in the process generate large quantities of waste sand that can no longer be used in the casting process. Non-reuseable sand accounts for 55 to 90 percent of the total waste stream of a facility. Nationally, only two percent of foundry sand is considered hazardous.[4] The remaining 98 percent is a non-hazardous industrial by-product that can be reused in a variety of products or disposed of in non-hazardous landfills.

The U.S. foundry industry uses approximately 100 million tons of sand per year. Roughly 90 percent is reused for making molds within the foundries, but 9 to 13 million tons of

[2] American Foundry Society.

[3] U.S. EPA. 1998. "Sustainable Industry: Metal Casting Industry Profile." U.S. EPA Office of Policy, Industry Sector Policy Division.

[4] U.S. EPA. 1998. *Metal Casting Industry Sector Notebook.* U.S. EPA Office of Compliance.

this sand is no longer useable in the casting process. Of this sand, approximately one million tons are recycled for other uses every year; the remaining 8 to 12 million tons are landfilled.[5]

Many foundries have invested in sand reclamation systems that can recover up to 95 percent of sand used in the casting process. These systems represent an important environmental and economic opportunity for foundries, helping to control production costs and to reduce the amount of waste for disposal. Even with this increase in sand reclamation, there is a limit to the number of times sand can be effectively reused in the casting process, eventually resulting in a large amount of used sand that could be beneficially reused elsewhere.

2.2 COMPOSITION OF FOUNDRY SAND

Casting processes used by foundries involve a variety of sands, inorganic and organic binders, and other additives. They generate residues in the sand, including metals from the castings and compounds from binders used to form the sand into molds. The presence of these residues and the mixing of used sand with dust and other fine-grained foundry waste materials can limit the reusability of foundry sand.

Foundries use screening systems and magnetic separators to segregate reusable sand from other wastes and to separate particles of varying sizes. By carefully monitoring the casting process and used sand, foundries can ensure that their sand is largely free of excess contaminants and qualifies as a non-hazardous industrial by-product.

2.3 POTENTIAL CONTAMINANTS IN FOUNDRY SAND

Several studies have been conducted to characterize foundry sand and evaluate the likely environmental impacts of reusing sand. These studies primarily rely on tests of the potential for various constituents to leach from the sand, such as the Toxicity Characteristics Leaching Procedure (TCLP), which measures constituent concentrations dissolved in an acidic solution that has been in contact with the sand.[6]

2.3.1 Metal and Other Inorganic Contaminants

In general, TCLP results show that metal concentrations in foundry sand are below regulatory thresholds, such as those specified for hazardous waste by the Resource Conservation and Recovery Act (RCRA).[7] Many of the leachate concentrations measured were

[5] Foundry sand estimates are from Dr. Paul J. Tikalsky of Pennsylvania State University, collated from FIRST (Foundry Industry Recycling Starts Today) data.

[6] The TCLP is the most commonly used leach test, however, several states use the Synthetic Precipitation Leaching Procedure (SPLP). In addition, a number of states use other tests, such as a totals analysis, which is an analysis of the composition of the sand itself.

[7] E.S. Winkler and A.A. Bolshakov. 2000. "Characterization of Foundry Sand Waste." Chelsea Center for Recycling and Economic Development, University of Massachusetts at Lowell.

lower than federal drinking water standards, indicating it is generally safe to reuse these sands. Studies of foundry sand also indicate that metal contaminant concentrations are on the same order of magnitude as those in virgin sand and sandy soils.[8]

On the other hand, mixed foundry by-products from non-ferrous foundries (which contain a combination of sand, dusts, and slag) have occasionally been found to have metal leachate concentrations above RCRA thresholds.[9] For example, some foundry dusts have been found to have higher concentrations of metals relative to sand. Comparisons of the total metal content of sand to TCLP results found no direct correlation.

2.3.2 Organic Contaminants

The binder system is the primary source of organic contaminants in sand. The primary organic contaminants from foundry sand cores are acetone and 1,1,1-trichloroethane, and a number of aromatic compounds, as shown in Exhibit 2-1. Green sand casting, which generally does not involve the use of organic binders, has been shown to have lower potential for leaching organic compounds than chemically bonded systems.[10]

Depending on the curing and pouring process, some of the organic binder constituents may be altered from their original composition. The more reactive organic compounds commonly used in binders and resins are of special concern, because they can be transformed into new hazardous compounds under incomplete combustion conditions.[11] However, testing has not indicated that these reactive compounds are found at significant concentrations in sand.

For example, of the 45,000 compounds tested in the ground water in the vicinity of foundry landfills in Wisconsin, none was found to be above 1 μg/L (ppb).[12] Several contaminants were found in trace quantities at less than 1 ppb in laboratory leachate tests, with the phenolic urethane and the phenolic isocyanate binder systems contributing the highest organic compound content, but no contaminants exceeded EPA drinking water standards. In aluminum foundries, which cast at a lower temperature, less of the organic binder is burned off, increasing the potential for residual organic contaminants to be present in the sand.

---

[8] Winkler and Bolshakov 2000.

[9] Winkler and Bolshakov reviewed studies of different leachate tests, including the following: (1) field leachate from landfills or sand reuse projects; (2) TCLP; and (3) EP [extraction procedure]. Both TCLP and EP are acetic acid extractions, but the TCLP extraction is performed at a lower pH, which tends to lead to higher extraction values.

[10] In some cases, starches and sea coal are added to green sands, which can lead to production of polycyclic aromatic hydrocarbons upon heating.

[11] In recent years, foundries have made efforts to reduce the use of these elements in their binder systems.

[12] As reported in Winkler and Bolshakov 2000.

Exhibit 2-1

PRIMARY ORGANIC COMPOUNDS FOUND IN FOUNDRY SAND CORES

Acetone[1]	Formaldehyde[2]
Benzene[1]	Isopropylbenzene[1]
2-chlorophenol[2]	1- and 2-Methylnaphthalene[1,2]
m/p-Cresol[2]	Naphthalene[1]
1,2-Dichlorobenzene[2]	Phenol[2]
1,4-Dichlorobenzene[2]	Tetrachloroethane[2]
Diethylbenzenes[1]	Toluene[2]
Dimethylnaphthalenes[1]	1,1,1-Trichloroethane[1]
2,4-Dimethylphenol[2]	1,2,4-Trimethylbenzene[1]
Ethylbenzene[2]	1,3,5-Trimethylphenol[2]
p-Ethyltoluene[1]	Xylenes[1,2]

Sources:
[1] Winkler and Bolshakov, "Characterization of Foundry Sand Waste," October 2000. Chelsea Center for Recycling and Economic Development, University of Massachusetts at Lowell.
[2] Michigan Department of Environmental Quality test results, Duane Roskoskey, October 2002.

3.0 REGULATORY ENVIRONMENT FOR REUSE OF INDUSTRIAL WASTE

EPA estimates that 7.6 billion tons of non-hazardous industrial waste are generated and disposed of annually in the U.S.[13] Promoting recycling is a stated priority for EPA's Office of Solid Waste and Emergency Response for Fiscal Year 2003.[14] Accordingly, EPA is emphasizing the importance of waste reduction and more efficient and sustainable use of resources. Looking to the future, the Agency anticipates that "many materials that are now considered wastes will instead be used to produce new materials and products. As this shift happens, it is likely that current distinctions between wastes and materials (which are in large part regulatory in nature) will become less meaningful. This could argue for government policies that more effectively promote, and reduce unnecessary regulatory constraints on, more efficient use of these materials."[15] For the foundry industry, such policies would translate into the development of regulatory approaches that encourage increased beneficial reuse of foundry sand. Although states play a primary role in establishing industrial waste regulations and guidance, there is a role for EPA to provide coordination and assistance at the national level to help achieve such a shift in waste management policy.

The anticipated shift in waste and materials management, along with opportunities for more effective regulatory approaches, suggests that the timing is well suited for stakeholders to focus on industrial waste reuse generally, and foundry sand reuse specifically. Because the majority of used foundry sand is considered non-hazardous industrial waste, it is important for foundries and end users of this material to understand existing state approaches to regulating waste reuse as they search for viable reuse opportunities. In addition, looking across different industrial waste reuse programs can highlight regulations or requirements that are particularly

[13] U.S. EPA. http://www.epa.gov/industrialwaste/, updated 6/24/02, as viewed July 9, 2002.

[14] U.S. EPA. http://www.epa.gov/swerrims/Mission.htm, as viewed July 9, 2002.

[15] U.S. EPA. "Beyond RCRA: Prospects for Waste and Materials Management in the Year 2020, A Draft White Paper," February 2001, p. 8.

informative, even transferable, to states wishing to refine their regulatory approaches to encourage increased reuse of industrial by-products.

This chapter provides a framework for understanding approaches used by states to regulate non-hazardous industrial solid waste reuse. It presents an overview of industrial waste reuse programs in 18 different states. The criteria used in selecting these states included:

- States with the largest number of foundries (and, thus, of greatest relevance to this effort, since they represent the greatest potential for reuse of foundry sands).
- States with active industrial waste reuse programs (although many more states than those included in this review have active industrial waste programs).
- States that have developed guidance specific to the beneficial reuse of foundry sand or have actively worked with the foundry industry on this issue.

This combination of criteria, along with previous knowledge of certain state programs and suggestions from participants in the Metal Casting Industry Performance Partnership, led EPA to focus on the states listed in Exhibit 3-1.

Exhibit 3-1

STATES SELECTED FOR REVIEW OF INDUSTRIAL WASTE REUSE REGULATIONS

• Alabama	• Maine	• Pennsylvania
• California	• Massachusetts	• Rhode Island
• Illinois	• Michigan	• Tennessee
• Indiana	• Minnesota	• Texas
• Iowa	• New York	• West Virginia
• Louisiana	• Ohio	• Wisconsin

3.1 FEATURES OF INDUSTRIAL WASTE REUSE PROGRAMS

The underlying concept of all the state reuse programs reviewed is to ensure the protection of human health and the environment by identifying and minimizing potential risks of reusing industrial wastes. This goal is accomplished through one or more of the following approaches: requiring risk assessments for each proposed reuse project; developing general concentration thresholds (both for leachate from the industrial waste and for contaminants in the waste itself) applicable to specific reuses; and implementing other requirements designed to prevent an unacceptable level of risk, such as restrictions on the siting of reuse projects and sampling and testing, notification, and reporting requirements.

The rules and guidance for industrial waste reuse vary significantly across the states reviewed. Some states have a single set of requirements for all industrial by-products or wastes, while others have developed specific regulatory requirements for individual types of industrial wastes (e.g., foundry sand, waste tires, fly ash). Of the 18 state programs described in this report, 11 states rely on requirements established for industrial solid wastes generally. The remaining seven specifically address the beneficial reuse of foundry sand in their rules or policies. (These programs are discussed in greater detail in Chapter 4.)

Exhibits 3-2 and 3-3 summarize the characteristics of state industrial waste reuse programs. Exhibit 3-2 indicates whether the state programs reviewed are general or specific to foundries, and focuses on their sampling requirements, constituent concentration thresholds, waste classification categories, and authorization processes. Exhibit 3-3 presents information on program requirements for siting and for frequency of industrial waste sampling and testing. Detailed descriptions of the state programs are presented in Appendix A.

3.1.1 Initial Sampling and Testing Requirements

All 18 states require an initial characterization of the industrial waste demonstrating that it qualifies as non-hazardous. This characterization typically involves a leachate test, with TCLP being the most frequently specified test. Five of the states (Louisiana, Maine, Pennsylvania, West Virginia, and Wisconsin) also require an analysis of the composition of the waste itself (totals analysis). In addition, a sampling and analysis plan (SAP) consistent with EPA's *Test Methods for Evaluating Solid Waste*, SW-846, is explicitly required by five states - Indiana, Maine, Michigan, Pennsylvania, and West Virginia - although several others require elements of an SAP.[16]

3.1.2 Constituent Concentration Thresholds

As Exhibit 3-2 illustrates, all but three of the states reviewed have developed concentration thresholds to which the initial testing results must be compared. Those states without established thresholds (Louisiana[17], Massachusetts, and Rhode Island), use the testing results as a starting point for evaluating the potential risks of an industrial waste reuse project.

---

[16] U.S. EPA, *Test Methods for Evaluating Solid Waste*, Document Number SW-846, Chapter Nine. EPA periodically updates sections of SW-846; an up-to-date version can be found at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm.

[17] Louisiana has no leachate thresholds, but does have allowable lifetime metal loadings (lbs./acre).

Exhibit 3-2

CHARACTERISTICS OF STATE INDUSTRIAL WASTE REUSE PROGRAMS

	Scope of Program	Testing Methods Required*	Individual Constituent Thresholds?	Basis of Leachate Thresholds (DWS, State DWS, RCRA)**	Waste Classification Categories?	Streamlined Authorization Process***
AL	General	TCLP	Yes	50 % of RCRA TC Levels	No	Prior Notice
CA	General	TCLP	Yes	RCRA TC Levels	No	--
IL	Foundry	TCLP	Yes	DWS	Yes (only 1 reuse category)	Prior Notice; Waste Exemption
IN	Foundry	TCLP	Yes	Variable % of RCRA TC Levels	Yes	Prior Notice; Waste Exemption
IA	Foundry/ Fly Ash	TCLP	Yes	90% of RCRA TC Levels	No	Waste Exemption
LA	General	TCLP, Totals	No#	--	Yes	General Permit
MA	General	TCLP, others##	No	--	No	--
ME	General	TCLP, Totals	Yes	Not specified	No	General Permit
MI	General	TCLP	Yes	10% of RCRA TC Levels†	Yes	--
MN	General	TCLP	Yes	RCRA TC Levels	No	--
NY	General	TCLP	Yes	RCRA TC Levels	No	--
OH	Foundry	TCLP	Yes	Up to 30x State DWS	Yes	Prior Notice; Waste Exemption
PA	General	TCLP, Totals	Yes	Variable % of RCRA TC Levels	No	General Permit
RI	General	Unspecified leachate, others††	No	--	No	--
TN	Foundry	TCLP	Yes	10x DWS	No	Prior Notice; Waste Exemption
TX	General	TCLP, other†††	Yes	Unknown	Yes	Prior Notice
WV	General	TCLP, Totals	Yes	DWS	No	--
WI	Foundry/ Fly Ash	TCLP, Totals	Yes	Variable multiple of DWS	Yes	Prior Notice; Waste Exemption

* TCLP: Toxicity Characteristic Leaching Procedure
Totals: Totals analysis to determine waste composition

** DWS: Federal Drinking Water Standards
RCRA TC Levels: Resource Conservation and Recovery Act Toxicity Characteristic threshold concentrations

*** Some states have developed streamlined authorization procedures for specific types of waste and reuses. These include:
Waste exemption – material is exempt from non-hazardous industrial waste regulations and can be freely reused.
Prior notification required for reuse – in some cases prior notice is combined with a requirement for some degree of review and approval.
General permits – these permits may be issued authorizing a particular type of reuse for qualified applicants.

Louisiana has no leachate thresholds, but does have allowable lifetime metal loadings (lbs./acre).

In Massachusetts, requirements for additional tests depend on the specific situation.

† This basis applies to incorporation of waste into asphalt or concrete. Michigan applies a one in one million risk factor for uncontrolled uses.

†† Rhode Island requires representative waste characterization, including physical and chemical analyses, but does not specify testing methods.

††† Seven-day distilled leachate test required for some class definitions.

Exhibit 3-3

OTHER REQUIREMENTS OF STATE INDUSTRIAL WASTE REUSE PROGRAMS

	Siting Requirement Considerations									Waste Sampling and Testing Frequency
	Potable Wells	Ground Water	Surface Water	Wetlands	Floodplain	Soil Type	Critical Habitat	Residential	Other	
AL				X	X			X	a	4 times per year
CA	----------Not Applicable----------									Not specified
IL	----------Not Applicable----------									Every year
IN				X	X		X		b	Every 2-5 years
IA	----------Not Applicable----------									4 times per year to every year
LA	X	X	X	X	X	X	X		c	Every year
ME	X	X	X	X			X			Not specified
MA	----------Not Applicable----------									Not specified
MI	----------Not Applicable----------									Every year
MN		X	X	X	X	X		X	b,d	Not specified
NY	----------Not Applicable----------									Variable
OH	X		X	X	X			X	e	Every year
PA	X	X	X	X						Every year
RI	----------Not Applicable----------									Every year
TN	X	X	X		X	X				Every 2 years
TX	----------Not Applicable----------									Not specified
WV		X	X		X	X				Every year
WI		X	X	X			X		d	Every 1-5 years

a. Less than 5 feet above an aquifer
b. Karst topography
c. Sensitive ecologic areas within 1,000 ft
d. Air emissions
e. Leach field

3.1.3 Waste Classification Categories

Seven of the state programs reviewed have created waste classification categories in an effort to encourage beneficial reuse. These categories are defined by ranges of contaminant thresholds for specific reuses and/or waste types. The underlying logic is that reuse projects involving "cleaner" wastes, smaller volumes of waste, and activities that are less "risky" should have fewer restrictions placed on them. For example, there are fewer restrictions on using an industrial waste for manufacturing another product, which has a very low potential for causing adverse environmental impacts, than on applying waste to agricultural soils.

States face trade-offs in deciding whether to establish a waste reuse classification system. While a classification system requires an up-front investment of resources on the part of regulators, it can streamline the process for reviewing and authorizing reuse projects. And while states that do not develop a classification system retain a higher degree of control in evaluating each beneficial reuse project on its own merits, each reuse activity or project will likely require

additional state resources to determine whether the proposed reuse of material from a specific facility is appropriate.

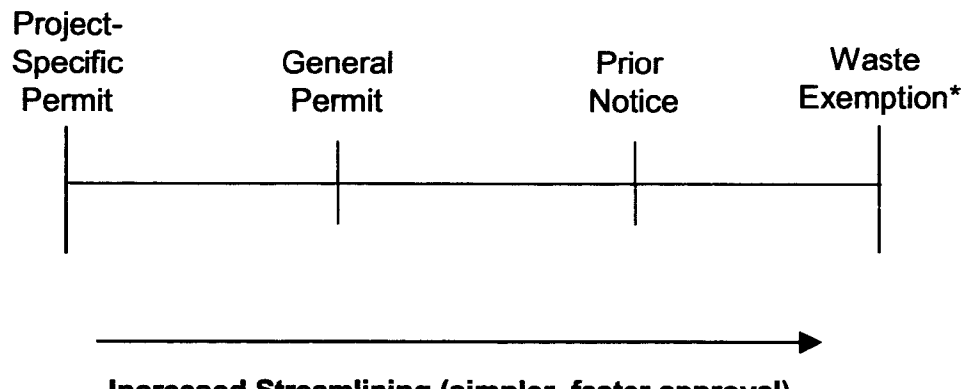
3.1.4 Authorization Process for Reuses

States use a variety of approaches for approving reuse of non-hazardous industrial waste. A key distinguishing factor across state programs is the extent to which they provide streamlined authorization processes, which can greatly reduce the effort required for a foundry and an end user to initiate and sustain a reuse project. Streamlined processes allow for other than case-by-case review of proposed reuses, thereby simplifying standardizing the review process, which can lead to a shorter and more predictable timeline for project approval. They also can lead to improved and more transparent decision-making by providing clear criteria for determining appropriate reuses.

Ten of the state programs reviewed have codified specific standards that define streamlined procedures, depending on the reuse activity, volume of waste to be reused, and contaminant concentrations present in the waste. These procedures range from general permitting to exempting wastes meeting strict criteria from industrial waste regulations. Specific streamlined procedures available in individual states are summarized above in Exhibit 3-2 (see far right column). The full spectrum of state approaches to project authorization is illustrated in Exhibit 3-4 and examples of these approaches are cited in Exhibit 3-5.

Exhibit 3-4

OPTIONS FOR STREAMLINING THE AUTHORIZATION PROCESS



* Exemption from classification as an industrial waste.

Exhibit 3-5

EXAMPLES OF TECHNIQUES FOR STREAMLINING THE AUTHORIZATION PROCESS

State	Authority	Website	Description
Waste Exemption			
Illinois	35 Illinois Administrative Code Part 817 – Requirements for New Steel and Foundry Industry Wastes Landfills	http://www.ipcb.state.il.us/Title_35 / main.htm	Sand meeting the leachate concentration thresholds can be reused without notifying the state (unless the sand is reused in land applications).
Tennessee	Beneficial Use of Nontoxic Spent Foundry Sand - Policy	http://www.state.tn.us/environment /swm/SWPolicyManual.pdf	Sand from iron and aluminum foundries meeting leachate concentration thresholds can be reused in certain uses without review or notification from the state, although the foundry must maintain project records on-site.
Prior Notice			
Alabama	Chapter 335-13-4.26(3) (Permit Requirements for Disposal of Foundry Wastes)	http://www.adem.state.al.us/Regula tions/regulations.htm	Prior to reuse, an applicant must "certify" the foundry waste by submitting a completed Solid/Hazardous Waste Determination Form and a TCLP analysis for metals. No response or approval from the state is required.
Indiana	Foundry Sand Waste Classification Guidelines	http://www.in.gov/idem/land/pubsf orms/guidance.html	Once the state has classified foundry sand as Type III or Type IV based on TCLP or totals testing, no additional state approval is required prior to reuse.
General Permit			
Louisiana	Title 33, Environmental Quality Part VII, Solid Waste, Subpart 1, Chapter 11, Section 1103 (C).	http://www.deq.state.la.us/planning /regs/ title33/index.htm	Land application only: "The administrative authority may issue a single beneficial-use permit for multiple beneficial-use locations provided that the permit application includes required information for each location, each location meets the standards provided in this Chapter, and the same solid waste stream (from a single generation site) is disposed of at all locations. The multiple locations will be considered as one facility and each location will be a unit of the facility."
Pennsylvania	Regulation: Chapter 287 of the Pennsylvania Code, Residual Waste Management - General Provisions General Permits relevant to foundry sand: WMGR016, WMGR019, WMGR021.	http://www.pacode.com/secure/data /025/chapter287/chap287toc.html http://www.dep.state.pa.us/dep/dep utate/airwaste/wm/MRW/docs/ GP_BU_PERMITS.htm	"*General permit*—A regional or Statewide permit issued by the Department for a specified category of beneficial use or processing of solid waste, the terms and conditions of which allow an original applicant, a registrant and person or municipality that obtains a determination of applicability, to operate under the permit if the terms and conditions of the permit and certain requirements of this article are met."

Waste Exemption

The most streamlined procedure is to grant an exemption from non-hazardous industrial waste management requirements when the material meets specified, stringent thresholds. Indiana and Iowa both exempt waste from notification requirements if it is certified to meet state reuse standards and is being used in a listed, state-approved activity.

Several states provide an exemption under more limited conditions. For example, in Ohio industrial waste material can be reused to manufacture another product without prior notification if it meets leachate thresholds equivalent to 30 times the state drinking water standards (DWS). To be reused in construction of roads and parking lots, though, the waste must meet leachate thresholds equivalent to five times the state DWS. In Wisconsin, wastes meeting specific thresholds are exempt from notification for a single reuse category – manufacturing another product.

Prior Notice

Many states have streamlined authorization procedures for industrial waste reuse that allow projects to proceed with only prior notification. In Ohio, prior notification is required for all transportation embankment projects, with certain large projects also requiring a degree of departmental review and approval.[18] Illinois and Alabama both require notification of any reuses on their approved lists, with Alabama also requiring departmental approval.

General Permits

States also issue general permits that allow multiple qualified applicants to engage in particular reuses. States implement this approach in several different ways. For example, Pennsylvania issues general permits that cover a particular reuse; any producer of waste material meeting the specified thresholds can apply to join the permit. Maine issues general permits that allow end users to receive by-products from generators without additional approval from the State. In Louisiana, most approvals are on a case-by-case basis, but permits can be issued for a specific reuse of waste material from multiple sources at multiple locations.

3.1.5 Other Common Requirements

In addition to the initial characterization of the waste, states frequently include siting and/or sampling and testing requirements in their programs to ensure that industrial waste reuse will be safe (see Exhibit 3-3).

---

[18] For projects in Ohio involving reuse of foundry sand and bottom ash, there is no need for prior notice if leach tests of the material consistently meet Ohio drinking water standards. However, facilities are required to submit project summaries to Ohio EPA.

Siting Requirements

Ten states place restrictions on the location of industrial waste reuse projects, such as minimum distance from ground-water, surface-water, and drinking-water sources; floodplains and wetlands; protected ecological and environmentally sensitive areas; and property fencelines.

Sampling and Testing Requirements

All state programs reviewed have requirements for the frequency of waste sampling and testing. These requirements can include follow-up sampling and testing to confirm that the waste's composition has not changed. This sampling may be conducted annually or if the process generating the waste changes. Typically, state programs also have requirements for notifying the relevant state agency of the reuse activity (*e.g.*, prior to initiating reuse project, annual reports of project status and conditions, and updates following any changes to the reuse process). There also may be requirements for notifying the public.

4.0 TAILORED REGULATION OF SAND REUSE

With costs for landfilling used sand typically ranging from $10 to $50 per ton in tipping fees plus transportation costs, foundries have a significant financial incentive to pursue alternatives to landfill disposal. States are also motivated to stretch their limited resources by streamlining the authorization process for reuses. For example, developing clear requirements for collecting, preparing, and submitting data can improve the quality of documentation that supports proposed reuses and reduce the need for follow-up submissions. In addition, some programs allow sand that meets stringent concentration thresholds to be reused without pre-approval from the state. In some cases programs even provide exemptions from the industrial waste regulations for qualifying sand (see discussion of streamlined authorization in Chapter 3). Of the 18 state programs EPA reviewed, seven have guidance or regulations specific to beneficial foundry sand reuse, including Illinois, Indiana, Iowa, Ohio, Tennessee, West Virginia, and Wisconsin.

While states' approaches to regulating foundry sand reuse are similar to those used for regulating industrial waste reuse in general, sand reuse programs specifically consider the characteristics of foundries and used sand, and the likely reuses. The many binders, curing processes, raw materials, and metals used in the casting process all affect the composition of foundry sand. The variation in sand composition across foundries poses a challenge in devising guidelines and/or regulations that provide for environmentally safe sand reuse. States have strived to tailor foundry sand reuse requirements by emphasizing areas of concern (such as particular metals and binder types used by foundries) and addressing likely reuse scenarios.

4.1 STATE APPROACHES TO REGULATING SAND REUSE

The set of regulatory tools selected by a given state reflects the trade-offs inherent in balancing the desire to encourage sand reuse with the need to protect human health and the environment. It is important to look beyond differences in a single program feature, such as leachate thresholds, and examine the full set of program requirements for sand reuse across states. Three major approaches to reviewing programs and policies are available to states wishing to amend an existing program or establish a new one.

4.1.1 Addressing Different Types of Foundries and Foundry Sand

Certain foundry operations and sand types are more likely to cause environmental concern than others. States vary in how they choose to address these. For example, Iowa's regulations address reuse of all types of sand; Tennessee's address reuse of sand from ferrous and aluminum foundries; and Wisconsin's address reuse of sand from ferrous foundries.

4.1.2 Combining Concentration Thresholds and Other Regulatory Requirements

States combine concentration thresholds and other regulatory requirements in a variety of ways to ensure that sand reuse is environmentally safe. For example, while leachate concentration thresholds in Illinois are among the most stringent, wastes meeting these thresholds are then exempt from industrial waste management requirements and can be reused in any way without regulatory oversight. Tennessee's leachate concentration thresholds are less stringent than Illinois', but applicants must submit reuse reports every two years and, in some cases, undergo a project review by the state. Wisconsin has less stringent leachate concentration thresholds than Tennessee, but requires both additional testing and annual reuse certification.

4.1.3 Balancing Allowable Reuses and Regulatory Requirements

In developing programs, states strike a balance between the potential risks associated with a reuse and the stringency of regulatory requirements. For example, reuse of sand in a "less-risky" activity, such as manufacturing another product, is commensurate with a reduced regulatory burden for the applicant. Similarly, meeting more stringent regulatory requirements, such as lower concentration thresholds and more frequent sampling and testing of sand, will create a wider range of reuse possibilities, in terms of both the types of reuse and the volume of sand that may be used in a project.

4.2 COMPARISON OF STATE REQUIREMENTS FOR SPECIFIC REUSES

Comparing requirements for specific reuses of foundry sand provides additional insight into the approaches adopted by states. The following section presents requirements for the four broad categories of reuses across the seven states with programs that specifically address foundry sand reuse:[19] (1) manufacturing another product, (2) structural fill, (3) pipe bedding and backfill, and (4) soil manufacturing, soil amendments, land applications, and composting.

[19] Regulatory requirements across states for a fifth reuse category – landfill uses – are not included in this comparison because states generally require only that the sand be non-hazardous, and some states do not consider landfill applications as "beneficial reuse."

4.2.1 Reuse in Manufacturing Another Product

Description

In general, states define the beneficial reuse of foundry sands as a raw material in the manufacture of another product to include the following products:

- asphalt;
- bricks;
- cement;
- concrete block;
- flowable fill;
- grout; and
- lightweight aggregate.

Regulatory Requirements

Of all reuses, manufacture of another product is the most inert and poses the least environmental risk; consequently, it is one of the least stringently regulated reuses. As shown in Exhibit 4-1, in several states the foundry sand need only qualify as non-hazardous (e.g., meet RCRA toxicity characteristic (TC) levels using TCLP - Wisconsin) or marginally non-hazardous (90 percent of RCRA TC levels - Iowa). However, in most states the maximum allowable leachate concentration for constituents of concern ranges from values equivalent to federal drinking water standards to 30 times these values.

The process of obtaining approval for this type of reuse varies across states. For example, Iowa, Ohio, and Tennessee do not require the foundry to provide notification or seek agency review/approval prior to the start of the reuse project, so long as the sand meets the established concentration thresholds. However, in West Virginia, foundries must submit a Beneficial Use Plan and gain agency approval prior to reuse.

Exhibit 4-1

REUSING FOUNDRY SAND AS A RAW MATERIAL IN MANUFACTURING ANOTHER PRODUCT – COMPARISON OF MAXIMUM ALLOWABLE LEACHATE CONCENTRATIONS (in mg/L) AND OTHER REQUIREMENTS

CONSTITUENT THRESHOLDS							
RCRA METALS	**IL***	**IN***	**IA***	**OH**	**TN**	**WV**	**WI***
Arsenic	0.05	0.50	4.5	1.5	-	0.05	5.0
Barium	2.0	10.0	90.0	60.00	20.00	1.0	100
Cadmium	0.005	0.10	0.90	0.15	0.05	0.01	1.0
Chromium, Total	0.1	0.50	4.5	3.0	1.00	0.05	5.0
Lead	0.0075	0.50	4.5	1.5	0.50	0.05	5.0
Mercury	-	0.02	0.18	0.06	0.02	0.002	0.2
Selenium	0.05	0.10	0.90	1.00	0.50	0.01	1.0
Silver	-	0.50	4.5	-	-	0.05	5.0
OTHER CONSTITUENTS							
Benzene	0.005	-	0.45	-	-	-	0.5
Chloride	250.0	250	-	-	-	-	-
Copper	5.0	2.5	-	-	13.00	1,500 (totals limit)	-
Cyanide (Total)	-	0.20	-	0.60	2.00	0.60	-
Fluoride	4.0	-	-	12.0	-	12	-
Formaldehyde	-	-	-	-	300.0 (totals limit)	-	-
Iron	5.0	1.5	-	-	-	-	3.0
Manganese	0.15	0.05	-	-	-	-	-
Molybdenum	-	-	-	-	-	18 (totals limit)	-
Nickel	-	0.20	-	-	1.0	200 (totals limit)	-
Nitrate	10.0	-	-	-	-	-	-
Phenols (Total)	-	0.30	-	10.5	15.00	10.5	-
pH	-	6.0-9.0	5.0-10.0	-	-	-	-
Sodium	-	2,500	-	-	-	-	-
Sulfates	400.0	2,500	-	-	-	-	-
Sulfide (Total)	-	5.0	-	-	-	-	-
Zinc	5.0	2.5	-	-	-	2,800 (totals limit)	-
Basis for Thresholds	U.S. DWS	10% of RCRA TC levels	90% of RCRA TC levels	30x Ohio DWS	10x U.S. DWS	1% of RCRA TC levels	RCRA TC levels
OTHER REQUIREMENTS							
Monitoring Frequency for Sand	Annually	Every 2 - 5 years	Quarterly – Annually	Annually	Every 2 years	Annually	Every 1 - 5 years
Submission of Regular Reports	For each project	No	On-site records	On-site records	On-site records	No	Yes
Siting Requirements	N/A	Floodplain, Wetlands, Critical Habitat	N/A	SW, Potable Wells, Wetlands, Leachfields	GW, SW, Floodplain, Certain Soil Types, Potable Wells	GW, SW, Floodplain, Certain Soil Types	GW, SW, Wetlands, Critical Habitat

Notes:

* IN, IL, IA, and WI have concentration limits for additional constituents.

IN – The maximum allowable concentrations apply to Type IV waste classification.

WI – TCLP limits are Category V thresholds.

WV – based some of its thresholds on Ohio's Policy 400.007.

RCRA TC: RCRA Toxicity Characteristic thresholds. RCRA TC thresholds are approximately equivalent to 50 - 200 times federal drinking water standards (DWS); DWS are approximately equivalent to 0.5 – 2.0 percent of RCRA TC thresholds.

GW: Ground water

SW: Surface water

4.2.2 Reuse as Structural Fill

Description

Structural fill is one of the most common beneficial reuses of sand specified in the state programs reviewed. States tend to define structural fill in engineering terms, such as building or equipment supportive base or foundation, foundation backfill, road base, and sub-base. Illinois and Iowa do not use the general term "structural fill," but rather identify several specific uses considered to be "structural fill."

Regulatory Requirements

As shown in Exhibit 4-2, the constituent concentration requirements for reuse as structural fill are generally equivalent to those for reuse in manufacturing another product. However, Wisconsin requires that foundry sand meet Category 4 standards for reuse as structural fill, while the less stringent thresholds for Category 5 apply for reuse in manufacturing another product. In Ohio, foundry sand must meet more stringent leachate thresholds (ranging from the Ohio drinking water standards to 20 times these standards) to qualify for use as structural fill, compared to 30 times the Ohio drinking water standards for use as a raw material in manufacturing another product.

Reuse of sand as structural fill also tends to require a more intensive application/approval process. For example, Iowa requires foundries to obtain approval for use of sand in structural fill projects but not for manufacturing another product. Similarly, Tennessee requires review and notification prior to use in structural fill but not for use in manufacturing another product.

Exhibit 4-2

REUSING FOUNDRY SAND AS STRUCTURAL FILL - COMPARISON OF MAXIMUM ALLOWABLE LEACHATE CONCENTRATIONS (in mg/L) AND OTHER REQUIREMENTS

CONSTITUENT THRESHOLDS							
RCRA METALS	**IL***	**IN***	**IA***	**OH**	**TN**	**WV**	**WI***
Arsenic	0.05	0.50	4.5	1.0	-	0.05	-
Barium	2.0	10.0	90.0	40.00	20.00	1.0	10.0
Cadmium	0.005	0.10	0.90	0.1	0.05	0.01	0.025
Chromium, Total	0.1	0.50	4.5	2.0	1.00	0.05	-
Lead	0.0075	0.50	4.5	1.0	0.50	0.05	0.075
Mercury	-	0.02	0.18	0.04	0.02	0.002	0.01
Selenium	0.05	0.10	0.90	1.00	0.50	0.01	-
Silver	-	0.50	4.5	-	-	0.05	-
OTHER CONSTITUENTS							
Benzene	0.005	-	0.45	-	-	-	-
Chloride	250.0	250	-	-	-	-	-
Copper	5.0	2.5	-	-	13.00	1,500 (totals limit)	-
Cyanide (Total)	-	0.20	-	0.40	2.00	0.60	-
Fluoride	4.0	-	-	8.0	-	12	-
Formaldehyde	-	-	-	-	300.0	-	-
Iron	5.0	1.5	-	-	-	-	3.0
Manganese	0.15	0.05	-	-	-	-	-
Molybdenum	-	-	-	-	-	18 (totals limit)	-
Nickel	-	0.20	-	-	1.0	200 (totals limit)	-
Nitrate	10.0	-	-	-	-	-	-
Phenols (Total)	-	0.30	-	7.0	15.00	10.5	-
pH	-	6.0-9.0	5.0-10.0	-	-	-	-
Sodium	-	2,500	-	-	-	-	-
Sulfates	400.0	2,500	-	-	-	-	-
Sulfide (Total)	-	5.0	-	-	-	-	-
Zinc	5.0	2.5	-	-	-	2,800 (totals limit)	-
Basis for Thresholds	U.S. DWS	10% of RCRA TC levels	90% of RCRA TC levels	Ohio DWS to 20x Ohio DWS	10x U.S. DWS	1% of RCRA TC levels	RCRA TC levels
OTHER REQUIREMENTS							
Monitoring Frequency for Sand	Annually	Every 2 - 5 years	Quarterly – Annually	Annually	Every 2 years	Annually	Every 1 - 5 years
Submission of Regular Reports	For each project	No	On-site records	On-site records	On-site records	No	Yes
Siting Requirements	N/A	Floodplain, Wetlands, Critical Habitat	N/A	SW, Potable Wells, Wetlands, Leachfields	GW, SW, Floodplain, Certain Soil Types, Potable Wells	GW, SW, Floodplain, Certain Soil Types	GW, SW, Wetlands, Critical Habitat

Notes:

* IN, IL, IA, and WI have concentration limits for additional constituents.

IN – The concentration limits apply to Type IV waste classification.

OH – Maximum allowable concentrations and other requirements (e.g., reporting) vary according to the volume of foundry sand that is used in the project.

WI – TCLP limits are Category 4 thresholds.

4.2.3 Reuse as Backfill and Pipe Bedding

Description

Backfill and pipe bedding are unencapsulated fill, but specific definitions vary across the seven states. Ohio allows foundry sand to be used as pipe bedding or as fill for "empty borrow pits created during road construction or other construction activities." Tennessee allows foundry sand to be used as fill in "abandoned or closed mines or strip mine areas." Wisconsin's guidance broadly defines unencapsulated fill as "unconfined geotechnical fill material." It includes fill "as part of the construction of a building, parking area, utility trench, or other structural improvement, where the industrial by-product is not structurally confined."

Regulatory Requirements

Compared to the previous two uses, Ohio and Wisconsin have more stringent concentration thresholds for backfill. The other five states have the same thresholds for most uses, including backfill. In Ohio, foundry sand must meet 20 times the Ohio drinking water standards, at a minimum, and may be required to meet a lower threshold (the Ohio drinking water standards or five times the standards), depending on the specific project characteristics. In Wisconsin, the used sand must meet at least Category 3 standards, which are substantially more stringent than the Category 5 standards established for using sand in manufacturing another product.[20] In addition, to classify as Category 3, foundry sand must meet thresholds for three additional constituents (aluminum, antimony, and beryllium). In Illinois and Indiana, all foundry sand meeting the established concentration thresholds is exempt from state regulations and can be reused in any manner. Tennessee requires review and notification prior to use. Exhibit 4-3 summarizes the regulatory requirements applicable for use as backfill.

[20] Wisconsin uses five categories of waste, with Category 1 having the most stringent requirements and Category 5 having the least stringent.

Exhibit 4-3

REUSING FOUNDRY SAND AS BACKFILL – COMPARISON ACROSS STATES OF MAXIMUM ALLOWABLE LEACHATE CONCENTRATIONS (in mg/L) AND OTHER REQUIREMENTS

CONSTITUENT THRESHOLDS							
RCRA METALS	**IL***	**IN***	**IA***	**OH**	**TN**	**WV**	**WI***
Arsenic	0.05	0.5	4.5	1.0	-	0.05	0.05
Barium	2.0	10.0	90.0	40.0	20.00	1.0	4.0
Cadmium	0.005	0.10	0.90	0.10	0.05	0.01	0.005
Chromium, Total	0.1	0.50	4.5	2.0	1.00	0.05	0.10
Lead	0.0075	0.50	4.5	-	0.50	0.05	0.015
Mercury	-	0.02	0.18	0.04	0.02	0.002	0.002
Selenium	0.05	0.10	0.90	1.0	0.50	0.01	0.10
Silver	-	0.50	4.5	-	-	0.05	-
OTHER CONSTITUENTS							
Benzene	0.005	-	0.45	0.10	-	-	-
Chloride	250.0	250	-	-	-	-	-
Copper	5.0	2.5	-	-	13.00	1,500 (totals limit)	-
Cyanide (Total)	-	0.20	-	0.40	2.00	0.60	-
Fluoride	4.0	-	-	8.0	-	12	8.0
Formaldehyde	-	-	-	-	300.0	-	-
Iron	5.0	1.5	-	-	-	-	1.50
Manganese	0.15	0.05	-	-	-	-	0.25
Molybdenum	-	-	-	-	-	18 (totals limit)	-
Nickel	-	0.20	-		1.0	200 (totals limit)	-
Nitrate	10.0	-	-	200.0	-	-	-
Phenols (Total)	-	0.30	-	7.0	15.00	10.5	12.0
pH	-	6.0-9.0	5.0-10.0	-	-	-	-
Sodium	-	2,500	-	-	-	-	-
Sulfates	400.0	2,500	-	-	-	-	-
Sulfide (Total)	-	5.0	-	-	-	-	-
Zinc	5.0	2.5	-	-	-	2,800 (totals limit)	-
Basis for Thresholds	U.S. DWS	10% of RCRA TC levels	90% of RCRA TC levels	Ohio DWS to 20x Ohio DWS	10x U.S. DWS	1% of RCRA TC levels	U.S. DWS to 2x U.S. DWS
OTHER REQUIREMENTS							
Monitoring Frequency for Sand	Annually	Every 2 - 5 years	Quarterly – Annually	Annually	Every 2 years	Annually	Every 1 - 5 years
Submission of Regular Reports	For each project	No	On-site records	On-site records	On-site records	No	Yes
Siting Requirements	N/A	Floodplain, Wetlands, Critical Habitat	N/A	SW, Potable Wells, Wetlands, Leachfields	GW, SW, Floodplain, Certain Soil Types, Potable Wells	GW, SW, Floodplain, Certain Soil Types	GW, SW, Wetlands, Critical Habitat

Notes:
* IN, IL, IA, and WI have concentration limits for other constituents.
OH- Category 2 waste is the least stringent category in which foundry sand used for this application may fall.
WI- Concentration thresholds based on Category 3 requirements.

4.2.4 Reuse in Soil Blending, Land Applications, and Composting

Description

This category includes the following four related uses: soil blending ingredient, soil amendment, direct surface or subsurface application to land, and composting. These uses serve to improve the characteristics and performance of agricultural or horticultural soil. They involve mixing sand with soil prior to being applied, or direct application to land.

Regulatory Requirements

As shown in Exhibit 4-4, these reuses typically have the most stringent state requirements. Although four of the seven states do not explicitly allow land application and soil blending, facilities can seek state approval for these and other beneficial reuses by applying for a waiver or by proposing a reuse project for review. Following are the beneficial reuses specifically addressed by three states:

- ***Soil blending.*** Only **Ohio** specifies the beneficial reuse of foundry sand as an ingredient in commercial soil blending. Under the Ohio policy, the sand may constitute no more than 50 percent of the mixture, and the blended soil may be used only for growth of trees or ornamentals (excluding sod farms).[21] The mixture may not be used for growth of crops intended for human consumption. Thus, it may not be applied to grazed pastures, to home fruit/vegetable gardens, or to agricultural crops or fruit trees.

- ***Soil amendment.*** **Indiana** is the only state that identifies this beneficial reuse of foundry sand. The state defines "soil amendment" as "foundry sand that has been mixed with one or more other materials to form a product, which could then be sold, re-mixed, applied to land, or otherwise used as soil or as soil substitute..." Unlike Ohio, Indiana does not limit the volume of sand that may be incorporated into agricultural or horticultural soils.

- ***Land application.*** Only **Indiana** specifically allows direct surface and/or subsurface application of foundry sand to land. The sand must be evenly applied on lands intended for agricultural and/or horticultural use.

- ***Composting.*** **Ohio** and **Tennessee** allow this reuse, but not use as a post-composting additive or in land application.

[21] Permits for unrestricted use in soil blending can be obtained in Ohio on a case-by-case basis.

Exhibit 4-4

REUSING FOUNDRY SAND FOR SOIL BLENDING, LAND APPLICATIONS, AND IN COMPOSTING - COMPARISON ACROSS STATES OF MAXIMUM ALLOWABLE CONCENTRATIONS AND OTHER REQUIREMENTS

CONSTITUENT	Leachate Standards (mg/L)		Total Metals (mg/kg) Soil Standards	
	OH	TN[1]	IN[2]	IN[3]
RCRA METALS				
Arsenic	0.25	-	41	75
Barium	10.00	20.00	-	-
Cadmium	0.025	0.05	39	85
Chromium, Total	0.50	1.00	2,000	3,000
Lead	0.25	0.50	300	840
Mercury	0.01	0.02	17	57
Selenium	0.25	0.50	100	100
Silver	-	-	-	-
OTHER CONSTITUENTS				
Benzene	-	-	-	-
Copper	-	13.00[4]	750	4,300
Cyanide (Total)	0.20	2.00[5]	-	-
Fluoride	4.0	-	-	-
Formaldehyde	-	300.0		-
Molybdenum	-	-	75	75
Nickel	-	1.00	210	420
Nitrate	-	-	-	-
Phenols (Total)	3.5	15.00	-	-
pH	-	-	> 6.5[6]	-
Zinc	-	-	-	-
Basis for Thresholds	5x U.S. DWS (except for cyanide)	10x U.S. DWS	Based on Federal guidelines that govern the land application of sewage sludge 40 CFR 503	

OTHER REQUIREMENTS	IN	OH	TN
Monitoring Frequency for Sand	Every 2 – 5 years	Annually	Every 2 years
Submission of Regular Reports	No	On-site records	On-site records
Siting Requirements	Floodplain, Wetlands, Critical Habitat	SW, Potable Wells, Wetlands, Leachfields	GW, SW, Floodplain, Certain Soil Types, Potable Wells

Notes:

[1] Land application is not a specified use.

[2] Maximum allowable concentrations to use as a soil amendment. Concentrations are in mg/kg on a dry weight basis.

[3] Maximum allowable concentrations to use in land applications. Concentrations are in mg/kg on a dry weight basis.

[4] The concentration limit is a maximum contaminant level goal (MCLG) in the federal DWS.

[5] Concentration value is based upon modified TCLP extraction test; refer to ASTM method D3987-85.

[6] The pH requirement applies to soils with a cadmium concentration over 2 mg/kg dry weight.

IN- Use as a soil amendment or in a land application also requires that the sand meet Type III criteria (TCLP results of 10% of RCRA values).

OH- Soil blending and composting are allowed; plan approval is required for land application on a case-by-case basis.

5.0 PURPOSE OF CASE STUDIES

Four beneficial reuse projects were selected as case studies to demonstrate the breadth of reuse activities for foundry sand and the implementation of industrial by-product reuse regulations in different states. Exhibit 5-1 lists the location, type of reuse, and major participants for the case studies. In each of the four states, non-hazardous foundry sand must meet certain contaminant criteria to be certified for reuse. Each state specifies how the sand can be used. In most cases, the alternatives to reuse are to store or dispose of the foundry sand in a company-owned monofill or to send it to a landfill, where it is frequently used as daily cover.

Exhibit 5-1

BENEFICIAL FOUNDRY SAND REUSE CASE STUDIES

State	Type of Reuse	Participants
Ohio	Soil Amendment	Kurtz Brothers, Inc., Ford Foundry, and Dugan's Garden Center
Wisconsin	Structural Fill for Embankments	Waupaca Foundry and Wisconsin Department of Transportation
Michigan	Asphalt	Resource Recovery Corporation and Asphalt Paving, Inc.
West Virginia	Parking Lot Construction	HK Casting and Weston Ford

These case studies are success stories. They show how foundry sand can be reused under set guidelines with no adverse environmental impacts. Economic and operational considerations are also important elements of these reuse efforts that affect both the initial feasibility of a project and, ultimately, its sustainability. This chapter presents an overview of the case studies and summarizes their findings, focusing on the factors that were seen to facilitate beneficial reuse of sand and those that are barriers.

5.1 OVERVIEW OF FOUNDRY SAND REUSE CASE STUDIES

Following are brief descriptions of the four case studies. Appendix B provides more detailed descriptions that explore the state regulatory framework governing sand reuse, the performance of the sand (including environmental performance), and the economic and operational effects of reuse from the perspectives of the foundry and the end user.

5.1.1 Soil Amendment – Ohio

Kurtz Brothers, in Ohio, has been a leader in the reuse of foundry sand for the past 20 years. The company produces a variety of soil blend products that are sold directly and through garden centers throughout Ohio. The Ford Foundry in Brookpark, Ohio, has been the largest sand supplier to Kurtz for the past 15 years, providing over 240,000 tons of sand to Kurtz in 2001.

As part of an agreement with the state, Ford conducts sand leachate tests annually, and Kurtz conducts quarterly leachate and total metals tests on its soil products made with foundry sand. Kurtz also submits an annual report to the Ohio EPA, describing the test results and any problems that arose with the reuse. The major barrier to Kurtz's increasing reuse of sand is the high transportation costs associated with expanding the network of foundries supplying sand.

5.1.2 Structural Fill – Wisconsin

The Waupaca Foundry provides sand for structural fill in Wisconsin Department of Transportation (DOT) highway embankment projects. Ten months worth of excess sand (80,000 tons) was used in the latest project. Waupaca's sand was certified as meeting required Category 2 or 3 standards. The sand is mixed with bentonite clay so it is relatively impermeable. The embankment requires only a clay cap; no liner is needed. The leachate volumes from the embankment will be measured twice each year.

From Waupaca's perspective, two key factors contributed to the project's success: (1) Waupaca's process improvements minimized any additional screening required prior to reuse; and (2) the ability to have off-site storage near the project minimized transportation costs.

5.1.3 Asphalt – Michigan

The Resource Recovery Corporation (RRC), a foundry-owned collaborative effort, undertakes reuse projects with the sand and other foundry residuals collected from member foundries. By consolidating sand, RRC can provide a consistent, reliable supply to its end users. RRC produces fine aggregate for use in making asphalt. In 2001, RRC sent over 31,000 tons of processed foundry aggregate to Asphalt Paving, Inc. (API). API began to use foundry processed aggregate in its product in 1997 and had used over 125,000 tons of this material as of December 2001.

RRC's processing facility is located at an Allied Waste System landfill. As a result, RRC is able to complement its processing capability with long-term storage for future use and or disposal of residuals.

5.1.4 Parking Lot Construction – West Virginia

Since West Virginia approved foundry sand reuse in 2000, HK Casting has completed two projects reusing 21,000 tons of sand as sub-base for parking lots. The foundry produces 5,000 – 6,000 tons of sand a year, and the parking lot projects have reused all of its stored excess sand.

HK was a key player in working with West Virginia to develop the state's reuse policy. The additional testing requirement for reusing HK's sand for beneficial reuse is to conduct a totals analysis for four metals. The TCLP test was already required for disposal of reused foundry sand in a municipal landfill, although HK's sand must meet stricter leachate standards to be reused.

For each project, HK submits a reuse plan to the state that includes the use, location, and amount of sand proposed for reuse. The state inspects the proposed reuse site to ensure that it meets all requirements. It also has the authority to inspect and monitor the site any time before, during, or after the beneficial reuse project.

5.2 SUMMARY OF FINDINGS

The fundamental finding from the four case studies is that all of these projects have safely and successfully reused foundry sand following different state regulations or guidance. In addition to there being no violations of state regulations, none of the state representatives reported any significant public concern over foundry sand reuse or any legal challenges.

5.2.1 Differences in State Reuse Programs

All four states require that leachate tests be performed on a regular basis. These tests address the potential for metals and additional contaminants (e.g., phenol and cyanide) to leach from the sand. Beyond the minimum requirements, there is some variability among the states, both in the parameters tested and in the thresholds specified. Chapters 2 and 3 as well as Appendix A provide a more in-depth discussion of these differences.

Three states (West Virginia, Ohio, and Michigan) base their thresholds on the federal hazardous waste guidelines (40 CFR 261.24), which establish thresholds for classification of waste as hazardous based on leachate characteristics determined through the TCLP.[22] State limits for various beneficial reuses are set at varying ratios relative to the federal regulatory levels. West Virginia has the most stringent requirements: for all beneficial reuse projects, the

[22] EPA Test Method 1311, specified in EPA SW-846.

TCLP results for foundry sand must be at least 100 times less than the federal hazardous waste thresholds. In Michigan, the limit for foundry sand to be considered for contained uses, such as asphalt or concrete, is set at 10 percent of the federal guidelines, or 10 times the threshold for an inert material suitable for general reuse (whichever is higher). Wisconsin tests for a set of parameters similar to those in the TCLP, but has adopted threshold values for each contaminant separately, rather than applying a set ratio to values set under the federal hazardous waste guidelines.

Most of the states have a category system that relates the characteristics of foundry sand to allowable beneficial reuses. Michigan, Ohio, and Wisconsin have systems based on contaminant levels in the sand, where reuse opportunities increase as the material meets stricter contaminant standards. West Virginia has a single-tier system: sand must meet the same strict threshold for all reuses. The differences among these states relate primarily to what threshold levels are chosen for different types of reuse. For example the acceptable thresholds for capped transportation embankments, an approved use in all four states, vary considerably – in many cases by more than a factor of 10.

5.2.2 Factors Affecting the Beneficial Reuse of Foundry Sand

The key motivating factor for reusing foundry sand, both for the foundry and the end user, is cost savings. Without reuse, foundries must pay for disposal of their sand, and the end user must purchase virgin material. In determining whether to reuse foundry sand, foundries weigh these disposal costs against the costs of segregating sand suitable for reuse from other by-products and transporting it to the location of a reuse activity. For the end user, the cost of virgin material is weighed against the cost of obtaining and using the foundry sand, including any testing that must be performed on products containing foundry sand, any potential delays associated with the reuse approval process, and any potential effect on sales of products containing an industrial by-product.

One foundry mentioned that it prefers to reuse sand rather than send it to a landfill to minimize the potential liability associated with becoming a future responsible party at a landfill site. The Wisconsin Department of Transportation included "civic duty" as part of the rationale for reusing foundry sand in its construction projects, noting that encouraging reuse rather than landfilling was everybody's responsibility. While important, these advantages are clearly secondary to economic considerations. They were cited as significant only when the costs of reusing foundry sand were comparable to the costs of using virgin material.

Looking across all four case studies, five factors appear to be critical to the long-term success of beneficial reuse activities. These case studies also suggest three factors that represent barriers to beneficial reuse of foundry sand. These factors are listed in Exhibit 5-2 and discussed below.

Exhibit 5-2 FACTORS AFFECTING THE BENEFICIAL REUSE OF FOUNDRY SAND	
Factors Contributing to Successful Reuse Projects	**Barriers to Reuse**
Streamlined regulatory process Proximity of foundry to reuse location Temporary storage facilities Reliable sand supply Consistent sand quality	Difficulty of finding new reuse opportunities Aesthetics of sand Large volumes of sand required for certain reuse projects

Factors Contributing to Successful Reuse Projects

Streamlined Regulatory Process

Several interviewees emphasized the importance of a streamlined approval process designed to facilitate the reuse of industrial by-products. For example, before the promulgation of current regulations in Wisconsin, an activity involving the beneficial reuse of sand could not be initiated without the submittal of a formal request with extensive documentation to the Department of Natural Resources (DNR). This type of notice was required for each individual foundry sand reuse project. Under the current regulations, once a foundry has its sand certified as meeting particular contaminant criteria, the sand can be used in multiple projects involving activities for which the sand is qualified without approval by the DNR unless very large volumes of material are used. The foundry is required to re-certify the quality of its sand twice a year and notify the DNR how it is being reused.

Proximity of Foundry to Reuse Location

Transportation is generally the largest expense associated with reuse, comparable to landfill costs in many areas even over short distances. Based on these case studies, the maximum feasible distance from a foundry to a project is 25 to 50 miles. Resource Recovery Corporation (RRC) in Michigan, a cooperative formed by local foundries to promote reuse of their sand, is the only exception to this finding. Member foundries transport their sand up to 90 miles to RRC, which processes the sand and ships it additional distances to end users.

Temporary Storage and Reliable Supply

Temporary storage sites and a reliable sand supply go hand in hand. Together they ensure that when sand is needed for a project, it is available. Temporary storage sites can be a dedicated area at the reuse site or a monofill at the foundry from which sand can be removed as

necessary to meet high demand. A reliable sand supply guarantees that the material required for completing a project will be available when it is needed.

Consistent Sand Quality

Several end users mentioned the need for strict quality control at the foundry to provide homogenous material without random metal scraps or large chunks of casting cores. This need for consistent quality also affects the viability of reuse from the perspective of the foundry.

For example, Waupaca Foundry initially had to filter its sand so that it could be reused in construction projects. This represented an additional step that significantly increased the cost of reuse. With process improvements over the last 10 years, however, Waupaca no longer needs to put its sand through additional filters in order to have a homogeneous by-product, which has made reuse much more financially attractive.

Barriers to Reuse

Finding New Reuse Opportunities

From the foundries' point of view, one of the primary difficulties is that the reuse opportunities are generally limited to activities on each state's "pre-approved" list. For example, when Waupaca Foundry submitted its application for reusing sand in pre-approved construction activities, it also submitted an application to use blended foundry sand and baghouse dust as liner material in manure pit construction (a reuse not on Wisconsin's pre-approved list). Wisconsin DNR denied the manure pit reuse application because of uncertainty about the environmental impact of this activity. DNR would not approve this reuse unless Waupaca could provide permeability and leachate test results on the proposed pit design. Such research and testing is often not economically feasible for an individual foundry, making it difficult for a foundry acting alone to develop new reuses.

The ability of foundries to develop new uses is also limited by transportation costs. For a reuse project to be economically feasible, it must be located relatively close to the foundry or the transportation costs become prohibitive. As noted above, these case studies suggest that distances of up to 50 miles are feasible for projects involving a single foundry.

Aesthetics of Foundry Sand

Officials in several states mentioned that the dark brown or black color of foundry sand prevents its use in situations where it is not covered. Wisconsin's DNR noted that a Category 2 foundry sand, (such as that produced by Waupaca could theoretically be used as an anti-skid agent on roads in winter, but the sand's dark color might be aesthetically disturbing to the general public. A related issue is the stigma that can be associated with end products containing reused industrial by-products.

Large Volumes of Sand Required for Certain Reuse Projects

Many reuse projects require volumes of sand that exceed the amounts a small foundry can supply on a reliable basis. The Wisconsin DOT noted this as a concern in some of its projects. While the need for of large quantities of sand makes it difficult for small foundries to compete for projects, this creates opportunities for organizations that consolidate sand from multiple foundries for reuse, such as Kurtz Brothers and RRC.

5.2.3 Further Opportunities for Foundry Sand Reuse

To identify new reuse opportunities, foundries need to actively expand markets for current uses or pursue markets for new uses. Larger foundries and "middlemen," such as Kurtz Brothers and RRC, who consolidate and prepare sand for reuse, have the resources and knowledge to increase the reuse market. RRC is actively exploring additional uses for sand and other foundry residuals through research and development. It is especially interested in working with the Michigan Department of Environmental Quality to expand the list of pre-approved uses.

Foundries involved in these case studies have considered additional reuse possibilities on their own. For example, Waupaca indicated that it is hoping to expand into more "value-added" reuse products (e.g., concrete, flowable fill, and asphalt), while maintaining its market in reusing foundry sand in road embankment construction. However, this foundry's experience submitting an application for a new reuse activity not on the state's "pre-approved" list illustrates the challenges of attempting to expand the reuse market. It seems more likely that efforts involving multiple foundries, or organizations that consolidate sand from multiple foundries, will have the necessary resources to successfully expand sand reuse into new areas.

APPENDIX A

SUMMARIES OF STATE GUIDELINES AND REGULATIONS ON REUSE OF INDUSTRIAL BY-PRODUCTS

December 2002

TABLE OF CONTENTS

* These states have programs or regulations specifically for the beneficial reuse of foundry sand.

INTRODUCTION

This appendix contains individual summaries of the regulations and guidelines regarding the reuse of industrial by-products in 18 states. Each summary describes the state's current system for classifying waste, allowable beneficial reuses, sampling and analysis requirements, constituent concentration thresholds, and other requirements. It also lists staff contacts and websites for each state for obtaining additional information.

The criteria used to select the states to for this review of industrial waste recycling/reuse regulations included:

- States with the largest number of foundries (and, thus, of greatest relevance to this effort, since they represent the greatest potential for reuse of foundry sand).
- States with active industrial waste reuse programs (although many more states than those included in this review have active industrial waste programs).
- States that have developed guidance specific to the beneficial reuse of foundry sand or have actively worked with the foundry industry on this issue.

Six of the states reviewed for this effort are in the process of proposing or writing new beneficial reuse guidelines or regulations. The types of changes they are considering illustrate the dynamic nature of the regulatory landscape for beneficial reuse:

Alabama is planning on issuing a public notice of proposed changes to the state's beneficial reuse requirements in October 2002. Specific changes under consideration were not available at the time this report was completed.

Iowa was revising its reuse regulations (Administrative Code, Section 567, Chapter 108 – Reuse of Solid Waste) at the time of this report's publication. Iowa has proposed more universally approved uses for foundry sand, such as a raw material in concrete products and leachate control drainage material at sanitary landfills. Iowa has proposed changing the leachate

thresholds to 10 times the MCL for drinking water standards, and utilizing the Synthetic Precipitation Leaching Procedure (SPLP) instead of the TCLP. Some siting restrictions pertaining to floodplains, wells and sinkholes are also proposed.

Maine has established a workgroup to review the initial screening analysis requirements foe reuse, which currently consist of leachate thresholds for 579 contaminants. This workgroup is reconsidering the number of constituents included in the screening analysis, as well as their respective thresholds.

Massachusetts is revising its regulations to allow several methods of making beneficial use determinations. The methods include: (1) a comparative analysis of products made with and without beneficial use determination material; (2) the use of suitably analogous regulatory standards from other programs; and (3) a formal risk assessment, when necessary.

Michigan formed a workgroup to draft rules related to composting and beneficial use of waste materials in April of 2001. A draft version of these rules will be available for public comment in the fall of 2002.

Minnesota is drafting an amendment to its solid waste management rules to streamline and clarify the reuse of solid waste. While foundry sand is not specified in the current draft (July 20, 2001), Minnesota has indicated its intention to list certain uses of foundry sand as "unregulated" in the amendment. Once generators of by-products demonstrate that their material meets requirements specified by the Minnesota Pollution Control Agency, they will be able to engage in any of the pre-determined reuses. Applicants will also be able to seek approval for additional by-products and uses.

STATE PROGRAM AND CONTACT INFORMATION						
State	**Most Relevant Regulation/Policy**	**Regulation/Policy Website(s)**	**Contact Name**	**Contact Position/Division**	**Contact Phone**	**Contact Email**
Alabama	Chapter 335-13-4 (Solid Waste Program Regulations)	www.adem.state.al.us/Regulations/Regulations/regulations.htm	Larry Bryant	Chief, Solid Waste Branch	334-271-7771	Landmail@adem.state.al.us
California	*Legislation*: California Health and Safety Code, Section 25140-25145 *Regulations*: Title 14 (non-hazardous waste management), Title 27 (waste disposal on land)	www.ciwmb.ca.gov/Statutes/HlthSaft.htm www.ciwmb.ca.gov/Regulations	Allison Reynolds	Permitting and Enforcement Division, California Integrated Waste Management Board	916-341-6873	areynold@ciwmb.ca.gov
			Peter Fuller	Division of Clean Water Programs, State Water Resources Control Board	916-341-5675	fullerp@cwp.swrcb.ca.gov
			Peggy Harris	Hazardous Waste Management, Department of Toxic Substances Control	916-324-7663	pharris@dtsc.ca.gov
Illinois	35 Illinois Administrative Code Part 817 - Requirements for New Steel and Foundry Sand Industry Wastes Landfills	www.ipcb.state.il.us/Title_35/main.htm	Ken Smith	Permits Section, Solid Waste Management	217-524-3280	EPA4423@epa.state.il.us
Indiana	Foundry Sand Waste Classification Guidelines	www.in.gov/idem/land/pubsforms/guidance.html	Tracy Barnes	Office of Solid & Hazardous Waste Management	317-308-3110	Tbarnes@dem.state.in.us
Iowa	Iowa Administrative Code, Section 567, Chapter 108 (Reuse of Solid Waste)	www.legis.state.ia.us/Rules/2002/iac/gnac/gnac1919/gna1920.pdf	Jeff Myrom	Policy & Budget Development, Waste Management Assistance Bureau	515-281-3302	Jeff.Myrom@dnr.state.ia.us

PROGRAM AND CONTACT INFORMATION						
State	**Most Relevant Regulation/Policy**	**Regulation/Policy Website(s)**	**Contact Name**	**Contact Position/Division**	**Contact Phone**	**Contact Email**
Louisiana	Title 33, Environmental Quality Part VII, Solid Waste, Subpart 1 (Solid Waste Regulations)	www.deq.state.la.us/planning/regs/title33/index.htm	Loni Gaudet	Small Business Assistance	504-736-7701	loni_g@deq.state.la.us
Maine	Chapters 405, 418, and 419 of Maine's Solid Waste Management Rules	www.state.me.us/sos/cec/rcn/apa/06/chaps06.htm	Clif Eliason	Bureau of Remediation and Waste Management	207-287-6115	clifton.g.eliason@state.me.us
Massachusetts	310 Code of Massachusetts Regulations 19.060 - (Beneficial Use of Solid Wastes)	www.state.ma.us/dep/bwp/dswm/files/310cmr19.htm	Sean Griffin	Bureau of Waste Prevention, Business Compliance Division	617-292-5967	sean.griffin@state.ma.us
Michigan	Part 115 Administrative Rules R299	www.michigan.gov/deq/0,1607,7-135-3312_4123-9861--,00.html	Lonnie Lee	Solid Waste Management	517-373-4735	LEELC@michigan. Gov
Minnesota	Minnesota Rules, Chapter 7035: Solid Waste	www.pca.state.mn.us/waste/sw_mnrules.html	Dale Thompson	Solid Waste Permitting	651-296-5897	dale.thompson@pca.state.mn.us
			Dwayne Duncanson	Solid Waste Permitting	651-296-7072	duane.duncanson@pca.state.mn.us
			Pat Burfurt	Solid Waste Permitting	651-296-8745	pat.burfurt@pca.state.mn.us
New York	6 NYCRR Part 360 Solid Waste Management Facilities, Subpart 360-1 General Provisions	www.dec.state.ny.us/website/regs/360a.htm	Jeff Schmitt	Beneficial Use Section, Division of Solid and Hazardous Materials	518-457-7337	jcschmit@gw.dec.state.ny.us

PROGRAM AND CONTACT INFORMATION

State	Most Relevant Regulation/Policy	Regulation/Policy Website(s)	Contact Name	Contact Position/Division	Contact Phone	Contact Email
Ohio	DSW Policy 0400.007, Beneficial Use of Nontoxic Bottom Ash, Fly Ash and Foundry Sand, and Other Exempt Waste	www.epa.state.oh.us/other/pgfull.html	Chris Bowman	Agricultural/Sludge/PTI Unit, Division of Surface Water	614-644-2134	chris.bowman@epa.state.oh.us
Pennsylvania	Chapter 287 of the Pennsylvania Code, Residual Waste Management - General Provisions	www.pacode.com/secure/data/025/chapter287/chap287toc.html	Ron Hassinger	Bureau of Land Recycling and Waste Management	717-787-7381	rhassinger@state.pa.us
Rhode Island	Guidelines on Beneficial Use Determinations ("BUDs") for Source Segregated Solid Waste	www.state.ri.us/dem/pubs/regs/index.htm#WM	Chris Shafer	Waste Management Division	401-222-2797 x7511	cschafer@dem.state.ri.us
Tennessee	Beneficial Use of Nontoxic Spent Foundry Sand - Policy	www.state.tn.us/environment/swm/SWPolicyManual.pdf	Mike Apple Jeff Norman	Division of Solid and Hazardous Waste Management	615-532-0780	mapple@mail.state.tn.us jnorman@mail.state.tn.us
Texas	Environmental Guide for Texas Foundries 30 Texas Administrative Code, Chapter 335, Subchapter R	www.tceq.state.tx.us/admin/topdoc/rg/387.pdf www.tceq.state.tx.us/oprd/rules/pdflib/335r.pdf	Technical Analysis Team	Industrial and Hazardous Waste Permits Section	512-239-6412	None
West Virginia	Spent Foundry Sand Beneficial Use Guidelines	www.nrcce.wvu.edu/iof/FOUNDRY.PDF	Sudhir Patel	Office of Waste Management	304-558-6350 x265	spatel@dep.state.wv.us
Wisconsin	Chapter NR 538, Wisconsin Administrative Code, Beneficial Use of Industrial Byproducts	http://www.dnr.state.wi.us/org/aw/wm/information/wiacsss.htm	Paul Koziar	Bureau of Solid and Hazardous Waste Management	608-267-9388	Koziap@dnr.state.wi.us

ALABAMA

The Alabama Department of Environmental Management (DEM) specifies requirements for the reuse of foundry sand through its "*Requirements for Management and Disposal of Special Waste.*"[1] Foundry waste that exhibits less than 50 percent of each of the toxicity characteristic levels for metals, as defined by EPA's TCLP, may be managed in a variety of activities. If the waste does not meet that requirement, it can be managed at an approved recycle/reuse facility or at a landfill unit approved for the disposal of foundry waste.[2]

Waste Classification System

The DEM has a single-tiered waste classification system. All material must meet one set of leachate guidelines equivalent to 50 percent of the RCRA hazardous waste thresholds for metals.

Allowable Beneficial Uses

Alabama's permitting guidelines do not specify allowable beneficial uses. Instead, they prohibit the reuse of foundry sand in four geographic areas: floodplains, wetlands, residential zones, and areas less than five feet above the uppermost aquifer. Foundry waste from multiple foundries may be mixed and reused at one location, provided adequate documentation and recordkeeping is maintained for each foundry.

Constituent Concentration Thresholds

Exhibit A-1

Alabama's Leachate Thresholds for Reuse of Foundry Sand (in mg/L)

Arsenic	2.5
Barium	50.0
Cadmium	0.5
Chromium	2.5
Lead	2.5
Mercury	0.1
Selenium	0.5
Silver	2.5

[1] Alabama DEM, Land Division – Solid Waste Program. Chapter 335-13-4.26 (3), Disposal requirements for foundry wastes.

[2] Alabama is planning on issuing a public notice in October 2002 of proposed changes to the state's beneficial reuse requirements. Specific changes under consideration were not available at the time this report was completed.

Sampling and Testing Requirements

The state requires generators to certify their waste on a quarterly basis at a minimum, or whenever the process changes in such a manner that would significantly alter the test results. A Solid/Hazardous Waste Determination Form must be completed and submitted to the Alabama DEM, along with the TCLP analysis for metals meeting the thresholds described above in Exhibit A-1. For the form, the foundry must name the generator and describe the waste generating process, the physical state, and whether the sand will be used as fill material. Additionally, the Water Division of Alabama DEM must be contacted to obtain any necessary General Stormwater and/or NPDES permits at reuse sites.

Other Requirements

Each foundry must maintain records at its facility regarding the reuse of foundry sand. These records include a description of the site and its location within a specific township and range, and the volume of foundry sand managed at each location.

CALIFORNIA

California does not have a formal system in place to address beneficial reuse activities. Depending on the project, a proposed reuse activity involving foundry sand will require individual review by a combination of the California Integrated Waste Management Board (CIWMB), the Department of Toxic Substances Control (DTSC), the State Water Resources Control Board (SWRCB), the Regional Water Quality Control Board (RWQCB), and the local health or enforcement agency.

Waste Classification System

DTSC, which generally regulates hazardous and potentially hazardous wastes, may first need to review leachate testing and waste composition data to grant a waiver from hazardous waste regulations or reclassify the waste as non-hazardous "designated industrial waste." Similarly, the water boards and CIWMB may review leachate data and whole effluent toxicity data to determine if the waste is an "inert waste," which is subject to fewer regulatory requirements than other waste categories.

Allowable Beneficial Reuses

California regulations address the recycling/reuse of RCRA wastes and additional materials classified by the State as hazardous wastes ("non-RCRA hazardous wastes"), and outline provisions for reusing these wastes as a material in manufacturing. However, these provisions focus on testing to confirm the waste's composition and establishing that recycling/reuse is viable (e.g., the market for the material exists, the reuse does not constitute disposal, the material will not require processing or significant storage prior to reuse).[3] Additional standards exist for composting facilities using organic wastes, but there are no regulations for composting or land application of materials containing other solid wastes.

Constituent Concentration Thresholds

The only thresholds explicitly referred to by California environmental agencies are the RCRA toxicity characteristic leachate thresholds to determine if a waste is hazardous or non-hazardous.

Sampling and Testing Requirements

Leachate testing is required to evaluate all industrial wastes. Depending on the waste classification sought by the applicant, additional testing is also required, including, at a minimum, whole effluent toxicity.

---

[3] California Health and Safety Code, Section 25143, as viewed on http://www. leginfo.ca.gov/cgi-bin/waisgate?WAISdocID=73322119133+10+0+0&WAISaction=retrieve on May 17, 2002.

Other Requirements

Additional requirements depend on the proposed type of reuse. If the reuse will include soil operations or composting, then the State and Regional Water Boards must review the project in addition to the CIWMB, and each of these agencies can establish other requirements including public notification, siting limitations, additional testing, volume restrictions, special handling and storage requirements, etc. If the waste will be reused as a raw material in manufacturing, no Water Board review is required and the CIWMB is likely to establish less stringent requirements. In fact, the CIWMB has established a "Tiered Regulatory Structure" to provide a level of regulatory oversight commensurate with the impacts associated with a solid waste handling or disposal activity. An applicant can petition the CIWMB to reclassify the reuse project as a non-permit activity requiring less regulatory review.[4]

[4] Solid Waste Permitting and Enforcement Regulations - Title 14 California Code of Regulations, Division 7, Chapter 5, Article 3. May 17, 2002.

ILLINOIS

Illinois Environmental Protection Agency (IEPA) maintains a beneficial reuse system for ferrous foundry (SIC 331 and SIC 332, except SIC3313) wastes and wastes from foundry processes at business operations whose primary SIC Code is not included within 332. Once a generator determines that the leachate from a foundry sand meets the standards for a "beneficially usable" waste using the TCLP, the generator may pursue any reuse alternative that will not adversely affect human health or the environment, without notifying IEPA.[5] This streamlined approach does not apply to "beneficially usable" foundry sand used in land reclamation. If used foundry sand does not meet the beneficial reuse standards, a facility must file a "Petition for an Adjusted Standard" with the Illinois Pollution Control Board, which triggers a review of the proposed beneficial reuse project.

Waste Classification System

IEPA regulations define four classifications for foundry wastes: beneficially usable waste, potentially usable waste, low risk waste, and chemical waste. All beneficial reuse types are potentially allowable for "beneficially usable" wastes, whereas wastes in the other three classes must be landfilled, unless the generator files a "Petition for an Adjusted Standard."

Allowable Beneficial Reuses

IEPA does not provide a comprehensive list of acceptable beneficial uses. As long as the proposed reuse meets all other applicable requirements, "beneficially reusable" wastes can be used in any application that does not create a threat to human health or the environment. If the generator proposes land reclamation for the beneficial reuse, the applicant must also demonstrate that the use will not cause an exceedance of the applicable Illinois ground-water quality standards.[6]

Constituent Concentration Thresholds

The Illinois Administrative Code establishes maximum allowable leaching concentrations (MALCs) to determine whether a waste is "beneficially usable." Twenty-five of the parameter limits are based on federal National Primary Drinking Water Standards, and another seven are based on federal National Secondary Drinking Water Standards.[7] Illinois allows exceedances of

---

[5] Standards for the management of beneficially usable foundry wastes are found in 35 Illinois Administrative Code Part 817, *Requirements for New Steel and Foundry Sand Industry Wastes Landfills*.

[6] 35 Illinois Administrative Code Part 620, *Groundwater Quality*. Specific applicable standards are found in Part 620 Subpart C, *Nondegradation Provisions for Appropriate Groundwaters*, and Subpart D, *Groundwater Quality Standards*.

[7] Illinois standards are based on federal Primary and Secondary DWS but are not updated by reference to the federal standards. As a result, although some federal standards have become more stringent since Illinois' standards were established, Illinois' standards have not been revised. The constituents for which this discrepancy exists are: total trihalomethanes, manganese, copper, iron, sulfates, and total dissolved solids (TDS).

limits based on secondary standards, provided the applicant can show the limit increase will not result in an exceedance of the state's ground-water quality standards.

MALCs based on Primary Drinking Water Standards (in mg/L):

- Arsenic - 0.05
- Barium - 2.0
- Cadmium - 0.005
- Chromium - 0.1
- Lead - 0.0075
- Nitrate - 10.0
- Selenium - 0.05
- Fluoride - 4.0
- Benzene - 0.005
- Carbon Tetrachloride - 0.005
- 1,2-Dichloroethane - 0.005
- 1,1-Dichloroethylene - 0.007
- cis-1,2-Dichloroethylene - 0.07
- trans-1,2-Dichloroethylene - 0.1
- 1,2-Dichloropropane - 0.005
- Ethylbenzene - 0.7
- Monochlorobenzene - 0.1
- Styrene - 0.1
- Tetrachloroethylene - 0.005
- Toluene - 1.0
- 1,1,1-Trichloroethane - 0.2
- Trichloroethylene - 0.005
- Trihalomethanes (total) - 0.1
- Vinyl Chloride - 0.002
- Xylenes (total) - 10.0

MALCs based on Secondary Drinking Water Standards (in mg/L):

- Chloride - 250.0
- Manganese - 0.15
- Copper - 5.0
- Iron - 5.0
- Sulfates - 400.0
- Zinc - 5.0
- TDS - 1,200

Sampling and Testing Requirements

A representative sample of leachate extracted by TCLP using deionized water (ASTM Method D3987-85) from each waste stream must be used to characterize the expected constituents and concentrations of the leachate. Facilities must obtain representative samples of waste streams to be tested using ASTM Method D2234-76. Actual samples of leachate from an existing solid waste disposal unit or beneficial use site may be used if: (1) the waste in the existing unit is similar to the waste to be used or disposed; (2) the conditions under which the leachate was formed are similar to those expected to be encountered; and (3) leachate is sampled so as to be representative of undiluted and unattenuated leachate emanating from the unit.

The generator must test all individual waste streams annually. Additional testing is required if there is a change in raw materials resulting in a change in the waste's classification, the manufacturing process, or the waste's leachate characteristics, or if a new process is added that may generate a new waste material.

Other Requirements

The generator must submit to IEPA a certification containing the following information for each new recipient of the beneficially usable waste and for each new use location: (1) a detailed description of the process generating the material and the proposed use; (2) a demonstration that the proposed use will not cause an exceedance of any standards and will not adversely affect human health or the environment; (3) a physical description and analysis of the waste stream; (4) the results of leachate testing; and (5) any available ground-water monitoring data.

INDIANA

Indiana Department of Environmental Management (IDEM) has draft guidance for foundry waste classification[8] and two additional documents on the storage and use of foundry sands.[9] These documents, in combination with Indiana regulations (329 Indiana Administrative Code (IAC) Chapter 10), establish requirements for the reuse of "spent" foundry sands.

Waste Classification System

Indiana classifies beneficially reusable foundry sand into four categories and defines appropriate uses for each category. Land application and use as a soil amendment are limited to wastes meeting the most stringent standards. Generally, applicants must use the TCLP for waste analyses.

Indiana's classification system guides the beneficial reuse of foundry sand and other industrial by-products based on increasingly stringent concentration thresholds. Type I materials meet the least stringent thresholds, while Type IV materials meet the most stringent thresholds. Consequently, facilities with Type IV by-products have the greatest number of reuse options available to them. IDEM assigns a classification level to a waste based on a hazardous waste determination, which is followed by a waste characterization. Each relies on a representative sampling and testing program.

Allowable Beneficial Reuses

Type I waste can only be disposed of in a Type I landfill. Waste Types II, III, and IV can be used as daily cover at a landfill. In addition, Type III and Type IV can be used as:

- capped embankments;
- protective cover for landfill leachate collection systems;
- ground and site barriers;
- structural fill base;
- a raw material in other manufacturing processes; and
- in land application and soil amendments.

---

[8] *Foundry Waste Classification Guidelines*, undated draft prepared by the Indiana Office of Solid and Hazardous Waste Management. IDEM has since removed the draft guidelines from its web site, and has not yet issued a final document.

[9] *Storage of Type III Foundry Sands Prior to Legitimate Use*, January 10, 2000, and *Use of Foundry Sand in Land Application and as a Soil Amendment*, February 22, 2000, both issued by the Office of Land Quality.

Land application and use as a soil amendment are limited by:

- annual and lifetime application rates (dry tons per acre) based on numerical toxicity factors;
- federal regulations limiting the application of waste materials with cadmium;
- ceiling concentration limits for 10 constituents in the foundry sand (listed in 329 IAC 6.1-4-9(a)); and
- cumulative pollutant loading rates (listed in 327 IAC 6.1-4-9(b)).

Constituent Concentration Thresholds

Exhibit A-2

Indiana's Waste Classification Thresholds (in mg/L)

Parameter	Type I	Type II	Type III	Type IV
Arsenic	5.0	1.3	0.50	0.05
Barium	100	25	10	1.0
Cadmium	1.0	0.25	0.10	0.01
Chromium	5.0	1.3	0.50	0.05
Lead	5.0	1.3	0.50	0.05
Mercury	0.2	0.05	0.02	0.002
Selenium	1.0	0.25	0.10	0.01
Silver	5.0	1.3	0.50	0.05

Sampling and Testing Requirements

Before obtaining a waste classification, a facility must first perform a "waste determination" to establish that the waste is non-hazardous and does not contain PCBs or other wastes regulated by the Toxic Substances Control Act (TSCA) or the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). If a generator's knowledge is insufficient or inconclusive for the waste determination, the generator must perform an analysis in accordance with 329 IAC 10-7.1-4(a). Each waste stream must be tested separately, and testing must use TCLP extraction procedures. In specific cases, totals testing for metals may be acceptable in lieu of TCLP testing.[10] A minimum of three sample sets are required for waste determination and classification purposes. However, testing is not required for any constituents not introduced or created during the foundry manufacturing process.

[10] Totals testing may be accepted only when the 90 percent single-tailed, upper confidence limits derived from Student-T analysis for all observed constituent levels are below 20 times the TCLP regulatory threshold for each constituent.

Once the waste determination is completed, the generator must prepare a sampling and analysis plan (SAP) prior to sample collection and testing for the waste classification. IDEM uses Chapters 1 and 9 of EPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, during its waste determination and classification evaluations.

To use the waste as a land amendment, the end user must document the total heavy metals loading that occurs with its product and must retain these records on site, but is not required to submit this documentation to IDEM.

Once a facility obtains its waste classification, it may use the waste material for any of the approved uses for that category, until the classification expires. The standard duration for a classification is two years for new permits and five years for renewals that show no significant change. No reporting of amounts or types of reuse, or further analysis of end materials, is required.

Other Requirements

- IDEM may require additional testing (for additional constituents or additional samples) for waste classification.

- Foundry sand may not be stored or applied on land within areas of karst topography, in wetlands, in critical habitats of endangered species, or in floodways unless special arrangements are made to prevent environmental damage to these areas.

- Foundry sand may not be stored or applied on land in a manner that would create fugitive dust or particulate matter, or violate state or federal surface-water or ground-water quality standards.

- Exemptions and additional uses may be obtained by petitioning IDEM.

IOWA

Iowa establishes requirements for the beneficial reuse of foundry sand in its Administrative Code.[11] Chapter 108 applies exclusively to coal combustion residue and "used foundry sand," which Iowa defines as "residuals from the foundry industry which are derived from molding, core-making, and casting cleaning processes that primarily contain either individually or in combination sand, olivine, or clay and which by specified leach test are acceptable for reuse." Once spent sand is determined to meet certain thresholds, it can be reused without a solid waste permit in any of several uses listed in the regulations.

Waste Classification System

Iowa Department of Natural Resources (DNR) regulations and guidance on the beneficial use of foundry sand do not include a waste classification system. Used foundry sands meeting the concentration criteria can be beneficially reused in any of the uses discussed in the regulations. A foundry may petition Iowa DNR for the reuse of sand not meeting the requirements (i.e., concentration levels or proposed reuse applications) established in Chapter 108.

Allowable Beneficial Uses

Used foundry sand is exempt from a solid waste permit under specific conditions as described in Chapter 108 of the Iowa Administrative Code. Additionally, certain uses are considered to be beneficial use as a "commercial material" and do not require either a solid waste permit or authorization. These two categories of foundry sand reuse are described in the Code as: (1) *beneficial uses for which no permit is required* and (2) *uses for which no authorization is required.*

- ***Beneficial Uses for Which No Permit Is Required.*** Foundry sand may be used for the following beneficial purposes without a solid waste permit, in accordance with a foundry sand management plan (described below under Other Requirements):

  - daily cover at a landfill;

  - road ballast;

  - construction/architectural fill;

[11] Iowa Administrative Code, Section 567, Chapter 108 - *Reuse of Solid Waste* - was being revised at the time of this report's publication. Iowa has proposed more universally approved uses for foundry sand, such as a raw material in concrete products and leachate control drainage material at sanitary landfills. Iowa has proposed changing the leachate thresholds to 10 times the MCL for drinking water standards, and utilizing the Synthetic Precipitation Leaching Procedure (SPLP) instead of the TCLP. Some siting restrictions pertaining to floodplains, wells and sinkholes are also proposed.

- dike or levee construction, repair, or maintenance; and

- fill base for roads, road shoulders, parking lots, and any other similar use.

For use in levees, or any other beneficial reuse application not specified by Iowa regulations, the foundry must send prior written notification to Iowa DNR, which in turn has 30 days to respond. The use will be deemed appropriate if DNR does not issue a response.

- ***Uses for Which No Authorization Is Required.*** Foundry sand may be used for the following purposes without authorization, since these forms qualify as "commercial material":

  - raw material constituent for flowable fill (low-strength concrete material), or concrete, asphalt, and any other similar use where the used foundry sand is encapsulated while providing all or a portion of the aggregate and critical constituents necessary for production of the final product; and

  - production feedstock.

Constituent Concentration Thresholds

Iowa DNR established thresholds equivalent to 90 percent of federal RCRA TCLP leachate concentration limits found in 40 CFR 261.24. Any spent foundry sand possessing leachate concentrations less than or equal to these criteria (presented in Exhibit A-3, below) is considered acceptable for reuse. Also, the spent sand must be evaluated for pH using EPA Method 9045 and must possess a pH greater than or equal to 5.0 and less than or equal to 10.0 for reuse.

Sampling and Testing Requirements

A representative sample of leachate must be extracted by TCLP for classification of the spent foundry sand for beneficial reuse. The pH must be analyzed using EPA Method 9045. Quarterly sampling is required during the first year of each foundry sand beneficial reuse effort to establish a baseline, after which sampling must be conducted annually. In addition, current accumulations of used foundry sand may be made available for reuse and incorporated in the foundry sand management plan, provided that representative samples are taken to ensure compliance.

Exhibit A-3

Iowa Thresholds for Beneficial Reuse

Constituent	Threshold (in mg/L)
Arsenic	4.50
Barium	90.0
Benzene	0.45
Cadmium	0.90
Carbon Tetrachloride	0.45
Chlordane	0.027
Chlorobenzene	90.0
Chloroform	5.40
Chromium	4.50
o-Cresol*	180.0
m-Cresol*	180.0
p-Cresol*	180.0
Total Cresols*	180.0
2,4-D	9.0
1,4-Dichlorobenzene	6.75
1,2-Dichloroethane	0.45
1,1-Dichloroethylene	0.63
2,4-Dinitrotoluene	0.117
Endrin	0.018
Heptachlor (and its epoxide)	0.007
Hexachlorobenzene	0.09
Hexachlorobutadiene	0.45
Hexachloroethane	2.70
Lead	4.50
Lindane	0.36
Mercury	0.18
Methoxychlor	9.0
Methyl Ethyl Ketone	180.0
Nitrobenzene	1.80
Pentachlorophenol	90.0
Pyridine	4.50
Selenium	0.90
Silver	4.50
Tetrachloroethylene	0.63
Toxaphene	0.45
Trichloroethylene	0.45
2,4,5-Trichlorophenol	360.0
2,4,6-Trichlorophenol	1.80
2,4,5-TP (Silvex)	0.90
Vinyl Chloride	0.18
*If o-, m-, and p-cresols cannot be individually measured, the regulatory level for total cresols is used.	

Other Requirements

Beneficial use of spent foundry sand does not require a permit. However, it does require the development of a foundry sand management plan, which must include the following information:

- Description of a compliance assurance and sampling procedure to ensure that only foundry sands acceptable for reuse are accumulated and used. The defined sampling program must include, at a minimum, quarterly sampling for the first year, as a baseline, followed by annual sand sampling thereafter.

- Identification of storage site management controls for dust, stormwater runoff, and public access.

- An annual summary of how the spent sand was used. The annual report must be completed by March 1 of the following year and must be kept on site for at least five years, although the foundry need not submit it to Iowa DNR.

LOUISIANA

Louisiana's beneficial use program requires the issuance of a permit by the Department of Environmental Quality (DEQ).[12] The solid waste regulation addresses the beneficial use of solid waste in applications to land and does not necessarily restrict the type of solid waste that may be considered or the sources of industrial solid wastes. In general, the permit application requires that the solid waste meet standards on maximum allowable lifetime metals loading. For beneficial uses that involve application of solid waste to lands used for "food-chain" crops or "animal feed" crops, the solid waste must meet additional standards and testing (e.g., TCLP, pH, PCBs). Once issued a beneficial use permit, facilities must meet annual reporting and record-keeping requirements.

Waste Classification System

Louisiana loosely defines wastes by their general source (i.e., commercial, industrial, residential), and the state's solid waste regulations outline a classification system that identifies the types of facilities authorized for handling solid waste:

- **Type I**. A facility used for disposing of industrial solid wastes.
- **Type I-A**. A facility used for processing industrial solid waste (e.g., transfer station, incinerator waste-handling facility, shredder, baler, or compactor).
- **Type II**. A facility used for disposing of residential or commercial solid waste.
- **Type II-A**. A facility used for processing residential, infectious, or commercial solid waste (e.g., transfer station, incinerator waste-handling facility, shredder, baler, autoclave, or compactor).
- **Type III**. A facility used for disposing or processing of construction/ demolition debris or wood waste, composting organic waste to produce a usable material, or separating recyclable wastes (a separation facility). Residential, commercial, or industrial solid waste must not be disposed of at a Type III facility.

In general, beneficial use facilities and permit holders are subject to solid waste regulations (i.e., LAC 33, VII Chapters 1, 3, 5, 7, and 9). A person must obtain a permit before solid waste may be "discharged, applied, incorporated, injected, or deposited onto or into the land for the purpose of beneficial use." The permit does not necessarily have to be held by the solid waste generator.

[12] Title 33, Environmental Quality Part VII, Solid Waste, Subpart 1. Solid Waste Regulations, April 2002.

DEQ may issue a single permit for multiple beneficial use locations, provided: (1) the permit application provides information on each location; (2) each location meets the relevant standards; and (3) the same solid wastes stream (from a single generation site) is disposed of at all locations.

Allowable Beneficial Reuses

The state's solid waste regulations define "beneficial use" as a "use of waste material for some profitable purpose (e.g., using sludge as a soil amendment). Avoidance of processing or disposal cost alone does not constitute beneficial use." More specifically, Chapter 11, "Beneficial Use Facilities," discusses requirements for beneficial use of solid waste with respect to general land applications as well as application to "food-chain cropland" and "land used for animal feed only." The rule defines "food-chain crops" as "crops grown for human consumption; tobacco; and crops grown to feed animals that are consumed by humans" and "animal feed" as "any crop, such as pasture crops, forage, and grain grown for consumption by animals."

Constituent Concentration Thresholds

All beneficial use facilities must meet the operational standards with respect to the maximum allowable lifetime metals loading rates (lbs./acre) in Exhibit A-4 for land application uses:

Exhibit A-4

Louisiana's Maximum Allowable Lifetime Metals Loading (lbs./acre) Based on Exchange Capacity

	Soil Cation-Exchange Capacity, (meq/100g):		
	<5	5-15	>15
Lead	500	1,000	2,000
Zinc	250	500	1,000
Copper	125	250	500
Nickel	125	250	500
Cadmium	5	10	20
"Meq": milli-equivalent.			

Other metals not listed in Exhibit A-4 may be subject to restrictions based upon the metal content of the waste.

Application to food-chain cropland and to land used for animal feed must meet the following additional requirements:

- **Food-chain cropland.** The requirements are: (1) the pH of the solid waste and soil mixture must be maintained at or above 6.5; and (2) the application of cadmium from the waste may not exceed 0.5 lb. per acre.

- **Land used for animal feed**. The requirements are: (1) a waste-soil mixture must have a pH of 6.5 or greater at the time of the solid waste application or when the crop is planted (whichever occurs later); (2) this pH must be maintained while the food-chain crop is grown, and crops that require a lower pH will be considered on a site-specific basis; (3) the facility must submit an operating plan that demonstrates how the animal feed will be distributed to preclude human consumption and describes measures to safeguard against possible health hazards from entry of cadmium or other heavy metals into the food chain; and (4) concentrations of polychlorinated biphenyls (PCBs) in the solid waste must be less than 10 mg/kg.

Sampling and Testing Requirements

The applicant must conduct a detailed analysis of waste, including pH, phosphorus, nitrogen, potassium, sodium, calcium, magnesium, sodium adsorption ratio, and total metals.

Other Requirements

A permit application for beneficial use requires:

- Third-party certification that the proposed activity is a legitimate beneficial use of solid waste. Qualified, independent third parties include the following state agencies: Cooperative Extension Service, Department of Agriculture, and Department of Transportation and Development.

- Completion of the beneficial use application, Part I Form, describing the proposed use; proof of public notice regarding the permit's application; a letter from the state Resource Recovery and Development Authority stating that the operation conforms to the applicable statewide plan; and an Area Master Plan showing the location of major drainage systems, drainage flow patterns, the 100-year floodplain, and other pertinent information.

- Supplemental information, such as beneficial use location characteristics and environmental characteristics (e.g., list of designated wetlands, wildlife management areas, and other sensitive ecologic areas within 1,000 feet of the facility perimeter) and facility geology (e.g., general description of soils).

Once issued a permit, beneficial use facilities must comply with various standards, such as buffer zones, monitoring of incoming wastes, and application restrictions determined by surface hydrology. In addition, beneficial use facilities must submit annual reports and maintain all records specified in the application (e.g., semiannual soil waste mixtures tests and analyses, test parameters).

MAINE

Chapter 418 of Maine's Solid Waste Management Rules establishes the rules for the "beneficial use of 'secondary materials,'" exemptions, and general standards for beneficial use. A facility pursuing beneficial use projects must collect TCLP and totals analytical data and compare the results with screening standards for 579 constituents of concern.[13] Ultimately, beneficial use projects are evaluated by the Maine Department of Environmental Protection (DEP) on the basis of the risk they pose to human health and the environment.[14]

Waste Classification System

Maine defines "secondary materials" as "solid waste, separated from other solid wastes, that may be suitable for beneficial use." Most foundry sand probably would be considered by Maine to be secondary material, but some foundry sand may qualify as "special waste," which Maine defines as "any solid waste generated by sources other than household and typical commercial establishments that exists in such an unusual quantity or in such a chemical or physical state...that may disrupt or impair effective waste management or threaten the public health, human safety or the environment and requires special handling, transportation and disposal procedures."

Even for a special waste, a facility may petition for a variance from the waste classification, followed by an application for a beneficial use license. When a processing, industrial, or manufacturing facility is licensed to beneficially use a secondary material for fuel or raw material substitution, the generator supplying the secondary material to that licensed facility is not required to obtain a beneficial use license. For all other reuses, the generator must apply for approval, and in some cases the end user must obtain a license as well.

Prior to a pre-application meeting, the applicant must submit supporting documentation for the beneficial use proposal that (1) demonstrates the secondary waste is non-hazardous and (2) includes a description of the secondary material and its proposed use; the physical, chemical, and, where appropriate, biological characteristics of the secondary material; results of analytical testing that reflect all constituents that may reasonably be thought to be present and that may pose a risk to human health or the environment; the quantities, by weight and/or volume, of the secondary material; a description of any risk management techniques being considered; and, if it is known that a risk assessment is necessary, a description of the proposed protocol for conducting the risk assessment.

---

[13] Maine has established a workgroup to review the initial screening analysis requirements. The workgroup is reconsidering the number of constituents to include in the screening analysis, as well as their respective screening thresholds.

[14] Standards for the management of beneficially usable foundry wastes are found in Chapters 405, 418, and 419 of Maine's Solid Waste Management Rules.

Allowable Beneficial Reuses

Beneficial uses of secondary materials regulated by Chapter 418 include, but are not limited to, use in an industrial or manufacturing process, use as construction fill, and use as fuel. Residual material proposed for agronomic use is subject to Chapter 419, *Agronomic Utilization of Residuals*, of DEP's rules. Maine DEP may grant temporary approval for a pilot project or experimental project on a case-by-case basis.

Constituent Concentration Thresholds

The beneficial use of the secondary material must not result in a greater risk than that posed by current construction practices and materials, or in an aggregate risk to a highly exposed individual under the proposed use or all future planned uses exceeding an Incremental Lifetime Cancer Risk of 5×10^{-6} and a Hazard Index of 0.5. Facilities must meet screening standards for 579 contaminants to be considered as meeting the risk standard for those constituents. If analysis demonstrates that the secondary material contains levels of the constituents in excess of screening standards, then the applicant must demonstrate through a risk assessment and/or through risk management techniques that the beneficial use of the waste does not pose a significant threat to public health or an unreasonable threat to the natural environment.

Sampling and Testing Requirements

The applicant must submit a waste characterization sampling and analytical work plan, and TCLP analysis and totals analysis are required for all beneficial reuse applications. Any statistical analyses performed must be done in accordance with the requirements of EPA's *Test Methods for Evaluating Solid Waste,* SW-846, 4th edition, Volume II, Chapter 9. For land application or use as a soil amendment, each type of land application triggers a different set of requirements (buffer zones near water resources, annual loading rates, total loading rates).

Other Requirements

General standards for beneficial reuse include:

- If intended to be used as a raw material substitute in manufacturing, the beneficially used secondary material must perform as an acceptable substitute for the material it is replacing.
- If the secondary material is intended to be beneficially used as a product, it must meet or exceed the applicable generally accepted product specifications and standards for that product.
- The beneficial use will not pollute any waters of the state, contaminate the ambient air, constitute a hazard to health or welfare, or create a nuisance.

- A beneficial reuse may not be located in, on, or over any protected natural resource or be located adjacent to, and operated in such a manner that material or soil may be washed into, any protected natural resource.

- For ongoing beneficial uses, the licensee must submit an annual report containing a summary of activity during the past year, the sources of the secondary material received, and results of any waste characterization.

- The licensee must submit Maine DEP's standard form, *Application for Beneficial Use of Solid Waste.*

MASSACHUSETTS

The reuse of foundry sand in Massachusetts is governed by state solid waste management regulations. A working draft of new reuse guidelines is currently under consideration.

Waste Classification

Reuse applications are classified by the volume of material that is being reused. For uses requiring more than 20 tons of material for a single project, a separate application form is used.

Allowable Beneficial Reuses

Massachusetts does not define "allowable reuse activities." The reuse applicant must describe how the "proposed utilization will result in a viable and beneficial substitution of a discarded material for a commercial product or commodity" and demonstrate that the proposed handling, storage, use, and end products "will not adversely affect the public health, safety or the environment."[15] The local board of health comments on the application, and the Department of Environmental Protection (DEP) then makes a final determination as to whether the material will be handled in such a way that it will not become solid waste, whether the sand can be "feasibly processed and put to beneficial use" as specified in the application, and whether the proposed project can be completed in compliance with appropriate rules and regulations in such a way that will not cause an adverse impact.

Sampling and Testing Requirements

Sampling and testing requirements are not specified in the current Massachusetts regulations. With the application for reuse, a chemical and physical characterization of the potential reuse material, as well as identification of its quantity, quality, and source must be submitted. The chemical tests consist of pH, reactivity, TCLP testing, total metals, volatile organic compounds (VOC), and identification of any other appropriate constituents. For physical properties, size, density, percent solids, and liquid content must be specified. There is no set frequency for recharacterization, unless one is specified in DEP's approval of an application.

Draft Beneficial Use Regulation Revisions

The Business Compliance Division of DEP is redesigning the state industrial by-product reuse regulations (or "beneficial use of secondary materials," as named by the potential regulation). Under these revisions, the secondary material must meet or exceed all standards either for the raw material it is replacing or for the product it will become. Either a risk assessment must be performed or risk management techniques must be in place. The applicant may be required to inform all property owners of the existence and location of secondary

[15] 310 CMR 19.060 *Beneficial Use of Solid Wastes*, August 4, 2000.

material on their property. The risk assessments may be based on the Incremental Lifetime Cancer Risk due to the material, the Hazard Index, or applicable or suitably analogous health standards. These could include one or more of the following state standards: Drinking Water Quality Standards, Air Quality Standards, Contingency Plan Standards, or Surface Water Quality Standards. The permittee must keep records of ongoing beneficial reuse activities, including amounts, sources, and the results of any required testing specified in the permit.

The proposed regulations also enable DEP to issue generic beneficial reuse determinations, which would allow any person or entity to engage in the reuse activity, given adherence to the requirements and conditions of the specified policy.

MICHIGAN

Michigan's Solid Waste Management Act outlines a process for designating wastes as inert material or low-hazard industrial waste, thereby allowing beneficial reuse.[16] Designation as either type of waste involves petitioning the Michigan Department of Environmental Quality (DEQ). The petitioner must provide a description of the beneficial use and demonstrate that the waste does not contain constituent concentrations exceeding primary or secondary drinking-water standards. Once the waste classification is granted, the petitioner must conduct annual tests and submit the results to DEQ.

Waste Classification System

A facility may petition the director of DEQ to designate solid waste as inert material, compostable material, or low-hazard industrial waste, thereby qualifying it for reuse. Compostable material classification is not relevant to spent foundry sand, and significant crossover exists between inert material and low-hazard industrial waste.

- **Inert material.**[17] Facilities may petition to designate solid waste as inert material appropriate for general reuse, for reuse at a specific location, or for specific reuse instead of virgin material. Inert materials range from rock and excavated soil to chipped tires and low-hazard industrial waste (i.e., low-hazard industrial waste used as aggregate, road, or building material, ultimately stabilized or bonded by cement, limes, or asphalt).

- **Low-hazard industrial waste.**[18] Solid waste may be determined to be low-hazard industrial waste if: (1) it is a by-product of a production process from primary metals or fabricated metal industries (i.e., standard industrial classification (SIC) Code 33 or 34), and (2) the waste meets leaching requirements.

Allowable Beneficial Reuse

The rules for solid waste management specify standards and requirements for the following general categories of reuse:

- nondetrimental material managed for agricultural or silvicultural use;

- inert materials appropriate for general reuse;

---

[16] Part 115 Administrative Rules R 299.4118.

[17] See: (i) R 299.4114, Inert Material; (ii) R 299.4115 Criteria for designating inert materials appropriate for general reuse; (iii) R 299.4116 Criteria for designating inert materials appropriate for reuse at a specific location; and (iv) R 299.4117 Criteria for designating inert materials specific reuse instead of virgin material.

[18] See R 299.4122, Criteria for designating low-hazard industrial waste.

- inert materials appropriate for reuse at a specific location;
- inert materials appropriate for specific reuse instead of virgin material; and
- industrial waste classified as low-hazard industrial waste appropriate for general reuse.

Constituent Concentration Thresholds

The suite of relevant constituents and their thresholds varies, depending upon the type of reuse (e.g., agricultural use, substitute for virgin material). Solid waste designated as inert material appropriate for general reuse, use at a specific location, or a specific reuse instead of virgin material must meet a different set of constituents of concern and standards, depending on the waste classification. Because each combination of waste classification and reuse category will have its own set of requirements, the discussion from this point forward focuses on the criteria for the designation of low-hazard industrial waste originating from primary metals or fabricated metal industries (SIC codes 33 or 34).

For wastes classified as low-hazard industrial wastes, Michigan has established leachate thresholds for the following constituents: metals, halogenated volatile organics, nonhalogenated volatile organics, aromatic volatile organics, phenolic compounds, and formaldehyde.[19] The thresholds for metals, in mg/L, include:[20]

- Arsenic - 0.5
- Barium - 10.0
- Cadmium - 0.10
- Chromium - 0.50
- Copper - 10.0
- Lead - 0.50
- Manganese - 0.50
- Mercury (inorganic) - 0.02
- Nickel (soluble salts) - 1.0
- Selenium - 0.10
- Silver - 0.50
- Zinc - 50.0

For uses where the wastes may present an inhalation or direct contact hazard, the petitioner must provide the total concentration of each of the following chemical constituents:

- hazardous constituents listed in 40 CFR Part 258, Appendix II;
- constituents that have primary or secondary drinking-water standards (established under 40 CFR Parts 141 and 143), including total chloride, total nitrogen, total iron, total manganese, and total sulfates;
- total molybdenum and total sodium; and

[19] Metals listed in Table 101; halogenated volatile organics listed in Table 102; nonhalogenated volatile organics listed in Table 103; aromatic volatile organics listed in Table 104; phenolic compounds listed in Table 105, formalehyde, 10 mg/l.

[20] See R 299.4123, Table 101; threshold values for inorganic constituents.

- any indicator parameters that may be useful in establishing a ground-water monitoring program for the waste.

Sampling and Testing Requirements

The petition for reuse requires a description of the techniques used to sample and analyze waste. DEQ requires that the sampling and analysis be conducted in a manner consistent with EPA's *Test Methods for Evaluating Solid Waste*, SW-846, 3rd edition. To be representative of the waste, DEQ requires a minimum of four samples be collected.

For constituents that are present in the material at potential levels of concern, their leaching potential must be determined using any of the following tests: (1) toxicity characteristic leaching procedure (TCLP), EPA method 1311; (2) synthetic precipitation leaching procedure (SPLP), EPA method 1312; or (3) other test methods that are approved by DEQ and more accurately simulate conditions at the site. If a hazardous substance is reported present in a sample at concentrations above the waste classification criteria, a facility may demonstrate that the data are not statistically significant.[21]

Approved materials classified through this process must be re-tested at least annually, with test results submitted to DEQ. The director has the discretion to specify more frequent testing if the characteristics of the material vary significantly.

Other Requirements

The petition to classify waste involves completing DEQ's application form, which requires a general description of the material to be classified, including: (1) a description of the process used to produce the material; (2) a schematic of the process and list of raw materials; (3) maximum and average amounts of materials generated monthly and annually; (4) documentation that the material is not hazardous waste; and (5) a description of the proposed use or disposal method for the material.

---

[21] Acceptable testing methods are specified in R 299.4908.

MINNESOTA

Minnesota currently engages in a case-by-case approval process for the reuse of industrial by-products. No specific regulations are currently in place to manage the requirements of the reuse process. A waste use rule has been proposed and will have pre-approved uses and an approval process for those that are not pre-approved. Foundry sand is not listed in the currently available draft of the rule (July 20, 2001), but the Solid Waste Utilization Advisory Group will consider adding certain foundry sand uses to the pre-approved list after experience is gained with successful projects under the case-by-case approval process.

Waste Classification

Industrial by-products may be reused on a case-by-case basis.

Allowable Beneficial Reuses

No particular uses are specified in the Minnesota Solid Waste guidelines. However, on a case-by-case basis, foundry sand has been approved for reuse in asphalt.

Sampling and Testing Requirements

Current regulations do not specify sampling and testing requirements. However, under the proposed regulations, a sampling plan will be required that describes the appropriate chemical and physical characterization of the material.

Draft Beneficial Use Regulation Revisions

The Minnesota Pollution Control Agency (MPCA) is drafting an amendment to the solid waste rules to streamline and clarify the use of solid waste. While foundry sand is not specified in the current draft (July 20, 2001), MPCA has indicated its intention to include certain uses of foundry sand. Once generators of by-products demonstrate that their material meets requirements specified by MPCA, they may engage in any of the pre-determined reuse activities. Additional by-products and uses may also be approved by a petition to the MPCA.

The material must be non-hazardous, and for materials and uses not on the pre-approved list, the material must be a "suitable substitute for an analogous material or a necessary ingredient in a new product,"[22] and it must be demonstrated through a solid waste control plan that the reuse activity will not adversely impact human health or the environment. The applicant for a case-by-case determination must also present a distribution and marketing plan that details

[22] MPCA draft guidelines on the Utilization of Solid Waste. Solid Waste Utilization Advisory Group. http://www.pca.state.mn.us/waste/pubs/swrules-draftpolicy-0701.pdf. Dated July 20, 2001. MPCA hopes to finalize the rule by December 2003.

the handling, transport, and economic feasibility of the proposed reuse. If the reuse project is approved, the applicant will be required to submit an annual report describing the project.

NEW YORK

In 6 NYCRR Part 360 *Solid Waste Management Facilities*, the term "beneficial use" refers to materials that "before being beneficially used (as determined by the department), were solid waste." Part 360 authorizes the New York Department of Environmental Conservation (DEC) to make beneficial use determinations (BUDs) of industrial solid waste.[23] The regulation identifies 16 materials that are not considered solid waste when used in specified applications; spent foundry sand is not listed among those materials. The state may grant BUDs on a case-by-case basis, and has done so for foundry sand. A BUD is an exemption from regulation, not a permit, and is not subject to State Environmental Quality Review procedures, which include public notice and comment periods.

Waste Classification System

Part 360-1.15(b) (*Solid Waste Cessation*) identifies 16 materials that prior to the rule were considered solid waste; foundry sand is not listed. Examples of materials that are pre-determined as non-waste qualifying for beneficial use include uncontaminated newspaper, tire chips, uncontaminated soil excavated as part of a construction project, and non-hazardous petroleum contaminated soil. DEC also grants BUDs on a case-by-case basis.

Allowable Beneficial Reuses

For each identified material, Section 360-1.15(b) specifies acceptable beneficial use(s). For example, tire chips are not considered waste when used as an aggregate for road base materials, and uncontaminated soil excavated as part of a construction project may be used as fill material in place of soil native to the site of disposition. Because foundry sand is not listed, DEC must grant project-specific BUDs for reuses involving foundry sand. The following are examples of applications where DEC has granted a BUD for foundry sand, designating foundry sand as a non-waste and appropriate for reuse:[24]

- aggregate (i.e., asphalt, concrete, flowable fill, asphalt-hot-mix, black top);
- base (sub) and fill;
- cement (source of silica);
- landfill cover (daily); and
- landfill contour grading fill.

---

[23] 6 NYCRR Part 360 Solid Waste Management Facilities, Title 6 of the Official Compilation of Codes, Rules, and Regulations, revised November 24, 1999.

[24] "Granted Beneficial Use Determinations," March 6, 2002, http://www.dec.state.ny.us/website/dshm/redrecy/bud.htm.

Constituent Concentration Thresholds

To obtain a beneficial use determination, an applicant must prove that the waste is not hazardous and that the reuse will not create a threat to or damage human health or the environment. Part 360 does not specify constituents of concern or threshold concentrations. It simply defines "solid waste" as all waste "other than low-level radioactive waste...and other than hazardous waste as defined in Part 371...." To define hazardous waste, New York uses the toxicity characteristic thresholds established by EPA in 40 CFR Part 261 and prescribes TCLP as the testing method. The toxicity characteristic (TC) threshold levels for metals, in mg/L, include:[25]

- Arsenic- 5.0
- Barium- 100.0
- Benzene- 0.50
- Cadmium- 1.0
- Lead- 5.0
- Mercury- 0.20
- Selenium- 1.0
- Silver- 5.0

Sampling and Testing Requirements

Part 360-1.15 (*Beneficial Use*) does not specify a testing methodology for confirming the composition of solid wastes. Section 360-1.3 (*References*) identifies EPA's reference document, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods,* SW-846).[26] This document provides guidance on:

- conducting leachate testing, i.e., TCLP and SPLP; and
- developing sampling plans that ensure test samples are representative of the material.

Other Requirements

Petitions for case-specific BUDs must include the following:

- A description of the waste and its proposed use. This includes a description of the waste's chemical and physical characteristics under review; demonstration that there is a market for the proposed product (e.g., contract to purchase the

[25] 6 NYCRR 371.3(e), Table 1, Maximum Concentration of Contaminants for the Toxicity Characteristic.

[26] Section 360-1.3, References, also identifies the following EPA reference documents: (i) *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020), and (ii) *A Procedure for Estimating Monofilled Solid Waste Leachate Composition*, Technical Resource Document, EPA publication SW-924.

proposed product or to have the solid waste used in the manner proposed); and a description of the proposed product (e.g., demonstration that the proposed product complies with industry standards and specifications).

- Demonstration that the management of the solid waste will not adversely affect human health and safety, the environment, and natural resources.

- A solid waste control plan, including: (1) procedures for periodic testing of the solid waste and proposed product to ensure the product's composition has not changed significantly; (2) disposition of any solid waste that may result from the manufacture of the product into which the solid waste will be incorporated; (3) description of the type of storage (e.g., tank, pile) and the maximum anticipated inventory of the solid waste under review (not to exceed 90 days) before being used; and (4) procedures for run-on and runoff control of the storage areas for the solid waste.

- For material proposed for incorporation into a manufacturing process, the material must not require decontamination or special handling/processing before incorporation (i.e., to minimize loss of material or to provide adequate protection of public health and safety, the environment, and natural resources).

When granting a BUD, the DEC determines the precise point at which the material ceases to be solid waste. The petitioner may request that this change in classification occur elsewhere. DEC may revoke any BUD if it finds that the basis for the determination was incorrect, that it is no longer valid, or that there has been a violation of the conditions attached to the determination.

OHIO

Ohio EPA's beneficial reuse program classifies combinations of reuse and concentration levels into four categories, each of which triggers a distinct set of recordkeeping and reporting requirements. Concentration levels are determined by TCLP testing. In addition, the Division of Surface Water developed a guidance document for the beneficial reuse of spent foundry sands and other wastes.[27]

Waste Classification System

Each of Ohio's four categories represents combinations of beneficial uses and concentration thresholds that are similarly protective. Ohio EPA allows the most flexibility under Category 1 and the least flexibility under Category 4:

- **Category 1** uses do not require Ohio EPA review or notification and include the largest number of beneficial reuse types;
- **Category 2** uses do not require prior review but trigger "isolation distance" restrictions, and the facility generating the waste must submit an annual report describing each beneficial reuse project, the type and estimated volume of waste used, and leachate test results;
- **Category 3** uses require 30-day prior notification to Ohio EPA and trigger "isolation distance" restrictions; and
- **Category 4** uses, including those not listed in the guidance document, require 60-day prior notification and Ohio EPA consent.

Allowable Beneficial Reuses

Depending on the concentration thresholds met by each waste, potential beneficial uses of spent foundry sand (and other wastes) include:

- raw material in manufacturing another product;
- stabilization/solidification of other waste (for disposal);
- in-composting process (not post-composting additive);
- anti-skid agent/road surface preparation material;
- soil blending ingredient;

---

[27] DSW Policy 0400.007, *Beneficial Use of Nontoxic Bottom Ash, Fly Ash and Foundry Sand, and Other Exempt Waste*, November 11, 1994.

- daily landfill cover;
- structural fill;
- pipe bedding;
- sub-base or final cover for roads/parking lots;
- generator give-away programs;
- filling empty borrow pits; and
- land application.

Constituent Concentration Thresholds

To be eligible for beneficial reuse, leachate from a waste must at a minimum meet "non-toxic" thresholds, which under Ohio regulations are generally equivalent to 30 times the levels of Ohio's Drinking Water Standards (DWS) for arsenic, barium, cadmium, chromium, lead, mercury, and selenium. The numerical non-toxic criteria, in mg/L, include:

- Arsenic - 1.5
- Barium - 60.0
- Cadmium - 0.15
- Chromium - 3.0
- Lead - 1.5
- Mercury - 0.06
- Selenium - 1.0 [28]

Also, foundry sand leachate must not exceed the following thresholds, in mg/L, for the spent foundry sand to be non-toxic:

- Cyanide - 0.6
- Fluoride - 12.0
- Phenol - 10.5

Within the definition of "non-toxic waste," additional thresholds exist (20 times DWS, 10 times DWS, 5 times DWS, and DWS) to provide varying levels of beneficial reuse flexibility.

[28] The threshold for selenium is 20 times the Ohio DWS.

Sampling and Testing Requirements

Generally, the applicant must create three different composite samples from 6 to 12 discrete samples and apply the TCLP or modified TCLP (EPA Method 1311, ASTM D3987-85) to obtain an extract that can be analyzed for the following parameters: acidity, alkalinity, aluminum, arsenic, barium, cadmium, chlorides, chromium, copper, cyanide, fluoride, iron, lead, manganese, mercury, pH, phenol, selenium, specific conductance, sulfates, total dissolved solids, vanadium, and zinc. Ohio EPA requires three initial test results for each parameter, one for each of the three composite samples. If the beneficial use is in Category 3 or 4, the results must be submitted to Ohio EPA with the proposal. If the waste has been characterized in the previous 12 months and no changes have been made, those results may be used. Alternatively, the applicant may use the statistical procedure set forth in EPA's *Test Methods for Evaluating Solid Wastes*, SW-486, to evaluate a larger database that is representative of the material (e.g., monthly analysis from the preceding 12 months).

Annual tests must be performed on the waste materials, although the applicant generally does not need to submit the test results to Ohio EPA. The applicant must analyze the waste product whenever there is a change in the production process or raw materials. Any result that exceeds the non-toxic criteria must be reported immediately.

Other Requirements

Beneficial reuse of a waste covered by Ohio's policy document does not require a permit from Ohio EPA if the intended use complies with all the provisions in the policy document. However, the following general requirements apply to beneficial use projects:

- The generating facility should first explore and implement all feasible alternatives to reduce the volume and toxicity of wastes, as well as on-site recycling or recovery;
- The use cannot create a nuisance condition;
- Storage piles at the site or facility where the material will be used or stored prior to use cannot create a nuisance condition and are subject to erosion control practices;
- Waste may not be used, without a permit, in projects that would include placing the waste in a stream bed, wetland, leach field, or well, unless the waste is fully contained in a manufactured product.

PENNSYLVANIA

The Pennsylvania Department of Environmental Protection (DEP) issues general permits for combinations of residual waste processing and beneficial use on a regional or statewide basis.[29] Once a general permit exists, beneficial reuse is self-implementing. A facility interested in the beneficial reuse of a particular waste is not required to obtain an individual permit. Instead, the facility must apply for coverage under an existing general permit and be able to demonstrate compliance with all applicable requirements in the general permit.

Waste Classification System

General permits authorize combinations of residual waste processing and beneficial use on either a regional or a statewide basis. General permits apply to all beneficial reuse combinations that meet specific criteria and are not limited to individual facilities. Once a general permit has been issued, any facility intending to beneficially reuse residual waste may do so without applying for or obtaining an individual permit, provided the facility meets all requirements. Either DEP or an outside applicant may initiate the process for the issuance of a general permit.

A general permit application must include a physical and chemical description and analysis of the residual waste, a demonstration that the waste is non-hazardous, a description of how the waste was generated, a description of the proposed use, and a demonstration that the waste is capable of performing the desired functions in the intended use.

Allowable Beneficial Reuses

An applicant may propose any combination of residual waste processing and beneficial reuse for a general permit. To date, the DEP has issued three general permits relevant to the foundry industry:

- "Beneficial use of waste molding sand from gray and ductile iron foundries for use as pipe bedding," where the waste sand was generated in a no-bake molding process (Permit WMGR016). This applies to foundries in SIC Code 3321.

- "Beneficial use of waste foundry sand for use as a roadway construction material or as a component or ingredient in the manufacturing of concrete or asphalt products" (Permit WMGR019). This applies to foundries with SIC Codes 3321, 3322, 3325, 3365, 3369, 3532, 3568, and 3569, and applies only to waste foundry sand used with the following sand binders or binder systems in their mold production processes: phenolic urethanes, phenolic esters, phenolic hotbox, phenolic no-bake, furan no-bake, furan warmbox, furan

[29] Standards for the management of residual wastes are found in Chapter 287 of the Pennsylvania Code, *Residual Waste Management - General Provisions.*

sulfur dioxide, alkyd urethane, alkyd oil based core oil, and epoxy sulfur dioxide.

- "Beneficial use of waste foundry sand from an aluminum foundry for use as road bed construction material" (Permit WMGR021). This applies to foundries classified as SIC Code 3365.

Constituent Concentration Thresholds

An applicant for a general permit must propose concentration limits for contaminants in the waste and a rationale for those limits. In addition, if the waste is to be used without reclamation as a construction material, soil additive, soil substitute or anti-skid material, or otherwise placed directly onto the land, leachate from the waste can not exceed:

- 25 times the ground-water standards for metals and other cations; or
- the ground-water standards for contaminants other than metals and cations.

As a result, two general permits for similar waste but proposing different beneficial uses could establish two different sets of constituent concentration thresholds.

For pH, ignitability, and reactivity, as well as for each contaminant subject to the hazardous waste toxicity characteristic, the maximum concentration is equal to the value listed in Table 1 of 40 CFR Part 261.

In the three general permits targeting foundry sands, DEP approved a different set of parameters for each permit and, in some cases, different thresholds for the same constituent. Each general permit contains totals and leachate standards, which are presented in Exhibit A-5.

Sampling and Testing Requirements

When submitting a general permit application, the applicant must include a full waste characterization, an evaluation of the potential for the waste to leach into the environment, and a waste sampling plan that ensures an accurate and representative sample used for these analyses. Sampling and testing should use EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, to determine compliance with concentration standards. Applicants may use either the TCLP or the Synthetic Precipitation Leaching Procedure (SPLP) to conduct leachability evaluations on representative samples. The facility must propose a re-analysis frequency and the rationale for the specified frequency.

In the case of General Permit WMGR019, waste foundry sand obtained from storage or disposal stockpiles can be used for beneficial reuse if first analyzed for compliance with the chemical thresholds specified in the permit. Two additional requirements include:

- For inorganic parameters, one grab sample for every 50 tons of waste foundry sand that are excavated. Composite samples from the grab samples must then be formed and analyzed after every 1,000 tons of waste sand excavated.

- For organic parameters, one grab sample must be collected and analyzed for every 1,000 tons of waste sand excavated.

Other Requirements

Other requirements include:

- The applicant must submit an annual report that includes documentation of a recent waste analysis. For each new source of waste, the permittee must submit an analysis of a representative sample of the waste no less than 15 days prior to beneficial use.

- If residual wastes are blended for use, the applicant must demonstrate that each waste results in a beneficial contribution to the use of the mixed waste and that the consistency of the blend will be maintained.

- The applicant must provide written notice to each municipality in which the applicant intends to operate under a general permit.

- The storage, transportation, or use of the waste cannot create a nuisance or be harmful to public health, safety, or the environment.

- The reuse cannot cause ground-water or surface-water degradation.

- The applicant must maintain records on site for 5 years.

Furthermore, the waste cannot be: (1) used as valley fill material, to fill open pits from coal or other fills, or to level an area or bring an area to grade; (2) used within 100 feet of a perennial stream; (3) used in or affecting "an exceptional value wetland"; (4) used within 300 feet of a private or public water source; or (5) used or stored in direct contact with ground water or surface water.

Exhibit A-5

Total and Leachate Levels in Pennsylvania's General Permits for Beneficial Use of Foundry Sands

	Molding Sand from Gray and Ductile Iron Foundries for Use as Pipe Bedding (WMGR016)		Foundry Sand for Use in Roadway Construction Material, Concrete or Asphalt (WMGR019)		Waste Sand from an Aluminum Foundry as a Road Bed Construction Material (WMGR021)	
Parameter	**Total Levels (mg/kg)**	**Leachate (mg/L)**	**Total Levels (mg/kg)**	**Leachate (mg/L)**	**Total Levels (mg/kg)**	**Leachate (mg/L)**
Aluminum			--	5.0	--	5.0
Antimony			30	0.15	30	0.15
Arsenic	20	1.25	20	1.25	20	1.25
Barium	5000	50.0	5000	50.0	5000	50.0
Beryllium			1.0	0.1	1.0	0.1
Boron	7000	3.15	7000	3.15	7000	3.15
Cadmium	20	0.125	20	0.125	20	0.125
Chromium, Hexavalent	300	0.1	300	--	300	0.1
Chromium, Total	1000	2.5	1000	2.5	1000	2.5
Copper	700	32.5	700	32.5	700	32.5
Total Cyanide			--	0.2		
Fluoride			--	7.5		
Iron	--	7.5	--	7.5	--	7.5
Lead	200	1.25	200	1.25	200	1.25
Manganese	400	1.25	400	1.25	400	1.25
Mercury			20	0.05	20	0.05
Molybdenum			--	4.375	--	4.375
Nickel	200	2.5	200	2.5	200	2.5
pH	5.5 to 9.5	--	5.5 to 9.5	--	5.5 to 9.5	--
Selenium	60	1.0	60	1.0	60	1.25
Silver	400	2.5	400	2.5	400	2.5
Thallium			6.0	0.0125		
Zinc	1000	2.5	1000	125.0	1000	125.0
Benzene			0.8	0.005		
Benzoic Acid			0.57	--		
Ethylbenzene			70	0.7		
Naphthalene			8.0	--		
PHCs (petroleum hydrocarbons)			500	--		
Phenanthrene			80	--		
Phenols (total)			400	21	--	21.0
Resorcinol			0.08	--		
Toluene			100	1.0		
Total Organic Halogens			50.0	--		
1,2,4-Trimethylbenzene			11.0	--		
Xylene (total)			1000	10.0		
Toluene Sulfonic Acid	75	--				

RHODE ISLAND

The Rhode Island Department of Environmental Management (RIDEM) established guidelines for beneficially reusing source-segregated solid waste in 1999.[30] These guidelines outline RIDEM's approach for evaluating whether specific source-segregated solid waste (i.e., separating the proposed "useful" materials from the wastestream at the point of generation) that were not previously defined as recyclable materials may be reused.[31] The process by which RIDEM reviews a request to reuse a specific source-segregated solid waste is referred to as a "Beneficial Use Determination" (BUD).

Waste Classification System

To request a BUD for a proposed beneficial use, the applicant must first request a variance from the Solid Waste Regulations. By granting a variance, RIDEM is reclassifying a waste as a reusable source-segregated solid waste. Variances expire after one year unless otherwise directed by RIDEM, and renewal of a variance must be requested at least 60 days before the expiration of the existing variance. Positive BUD reviews result in reuse permits for an initial period of one year, which may be renewed for a period of three years.

Allowable Beneficial Reuses

RIDEM does not indicate allowable reuses, except to outline additional requirements for land application and manufacturing soil products. All proposed reuses are evaluated on a case-by-case basis.

Constituent Concentration Thresholds

RIDEM has not developed thresholds specifically for BUDs. For land applications, however, RIDEM will rely on components of the *Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases* - Rule 8.02 (Residential Direct Exposure Criteria) and Rule 8.8.00 (Compost Product Requirements and Distribution) to guide its evaluation.

---

[30] RIDEM, "*Guidelines on Beneficial Use Determinations ("BUDs") for Source Segregated Solid Waste*," December 1999.

[31] Authority for this policy is provided by the *Rules and Regulations for Composting Facilities and Solid Waste Management Facilities*, January 1997; the *Rules and Regulations for Reduction and Recycling of Municipal Solid Waste*, March 1997; and the *Rules and Regulations for Reduction and Recycling of Commercial and Non-Municipal Residential Solid Waste*, September 1996.

Sampling and Testing Requirements

Applicants for reuse projects, typically the end user, must include a characterization plan describing methods for sample collection and analyses, and demonstrating that the characterization will be representative of the waste material. This plan must consider: how the samples will be collected, what types of samples to collect, what type of physical and chemical analyses should be performed, what substances are present in the waste (and what is their variability), and what are the human health and ecological risks associated with beneficially using the solid waste in the manner proposed.

Other Requirements

Additional requirements include:

- minimizing or eliminating the environmental hazards associated with the proposed recycling of solid waste;
- demonstrating that the reused material is a viable substitute for traditional raw materials;
- demonstrating that the proposed reuse will not adversely impact public health and natural resources, including ground water, surface water, air, or other applicable environmental resources;
- assessing the extent to which an end market exists for the reusable material;
- describing the reuse and the controls that will be in place;
- demonstrating that the proposed reuse is not simply an alternate method of disposal; and
- describing the degree of processing the solid waste material has undergone and the degree of further processing that is required.

In addition, RIDEM may require the applicant to post public notice regarding the proposed BUD and/or hold a public workshop or hearing to allow for public participation.

TENNESSEE

The Division of Solid Waste Management within the Tennessee Department of Environment and Conservation (DEC) developed a policy for the beneficial reuse of nontoxic spent foundry sand.[32] Each foundry engaging in beneficial reuse projects maintains internal chemical analysis records on its material, indicating the material's non-toxic nature. Certain reuse methods require the submission of a notification to Tennessee DEC. Contaminant thresholds are based on TCLP limits.

Waste Classification System

TN DEC policy on the beneficial use of spent foundry sand does not establish a waste classification system. All aluminum and ferrous foundry sand that meets the contaminant thresholds listed below may be reused. Reuses are classified according to whether they do or do not require divisional notification.

Allowable Beneficial Uses

Under Tennessee policy, the following beneficial reuses of "nontoxic" materials do not require divisional notification:

- **Manufacturing Another Product.** Use as a raw material in manufacturing another final product, e.g., grout, cement, flowable fill, lightweight aggregate, concrete block, bricks, asphalt, roofing materials, plastics, paint, glass, fiberglass, ornamental ceramics and other non-land applications. (Soil materials are excluded.)

- **Stabilization/Solidification of Other Wastes (for disposal).** Use as a stabilization/ solidification agent for other wastes to be disposed of at an approved facility.

- **Use in a Composting Process.** Use in a regulated composting process, not including post-composting additive or land application.

- **Daily Cover/Final Cover of Landfills.** Use as a daily or final cover at a solid waste landfill, if all technical specifications are met for this intended use and approved by a permit.

- **Landfill Liner Protective Layer.** Use as a protective layer for landfill liners as part of an approved permit for the landfill.

- **Small Construction Projects.** Projects using no more than 200 tons for any single project and in which the material is stabilized. State waters must not be

[32] Tennessee DEC. *Beneficial Use of Nontoxic Spent Foundry Sand.* Undated.

affected by the project, and initial documentation of the nontoxic nature of the material must be filed with the Division of Solid Waste Management.

Certain other uses require Division project review, prior to initiation of the activity:

- **Structural Fill.** Various structural fill uses are accepted, provided that the application will be below the final surface grade of the project when completed. Some examples are building-supportive base or foundation; foundation backfill; construction material for road bases, parking lots, and embankments; construction fill material for planned commercial and residential projects; and backfill materials for utility lines.

- **Mines/Strip Mine Projects**. Uses as fill in abandoned or closed mines or strip mine areas where the plans are approved by the Federal Office of Surface Mines and the Tennessee Division of Water Pollution Control, as appropriate.

- **Other Uses**. The Director may approve other uses on an individual basis if they are consistent with this policy and protective of human health and the environment.

Constituent Concentration Thresholds

The leachate thresholds (in ppm) for beneficial use of spent sand, based on results of TCLP analysis, are as follows:

- Barium - 20.00
- Cadmium - 0.05
- Chromium - 1.00
- Copper - 13.00
- Cyanide - 2.00
- Lead - 0.50
- Mercury - 0.02
- Nickel - 1.00
- Phenol - 15.00
- Selenium - 0.5

In addition, total formaldehyde must be less than 300 ppm.

Sampling and Testing Requirements

Foundries must analyze their residual sand every two years for the above contaminants, or whenever process changes occur that may affect the composition of the sand.

Other Requirements

All projects require certain recordkeeping standards. Each foundry must maintain information on the amount of sand used; the nature, purpose, and location of its projects; records of chemical analysis, updated every two years; and any written approvals that are received from the Division of Solid Waste Management, as applicable.

For projects requiring divisional review, as specified above, foundries and the property owner of the reuse site must submit a notification form to the Division of Solid Waste Management. The major items covered in the form are:

- generator and proposed use of material;
- estimated volume of nontoxic foundry sand to be used;
- proposed silt/runoff control; and
- description of use location, including local land uses, soil types, floodplains, and ground and surface water locations.

TEXAS

The Texas Commission on Environmental Quality (TCEQ) and the Texas Cast Metals Association (TCMA) worked cooperatively in developing the Beneficial Reuse of Foundry Sand Program in the state of Texas, which educates foundries on how to use sand to its greatest potential. Originally tied to a statewide effort to reduce solid waste going to landfills by 50 percent (the "Clean Texas 2000" program), TCMA first issued guidance on the beneficial reuse of foundry sand.[33] In 2001, TCEQ published *An Environmental Guide for Texas Foundries*, which summarizes Texas' industrial solid waste regulations[34] and contains a chapter devoted to beneficial reuse of foundry sand.[35]

Depending on the particular characteristics of a sand wastestream, foundry sand might qualify as hazardous industrial waste, non-hazardous industrial waste, or "non-waste." TCEQ defines "non-hazardous wastes" as "any industrial waste that is not listed as hazardous and does not have hazardous characteristics." Non-hazardous industrial waste is then categorized into one of three classes.[36] While all classes of solid waste may be beneficially reused in Texas, reuse of hazardous or Class 1 non-hazardous waste may be subject to more restrictions.[37]

Waste Classification System

Non-hazardous industrial waste is categorized into three classes. Class 1 waste presents the greatest potential for adverse impacts on human health and the environment, while Class 3 waste presents the least potential for adverse impacts.

- **Class 1**. Due to the presence of certain constituents and properties, Class 1 wastes present the greatest potential for adverse impacts on human health and the environment. Class 1 wastes may require special handling.

- **Class 2**. Class 2 waste is any individual waste or combination of wastes that both is not hazardous and poses less risk than Class 1 non-hazardous wastes, but does not meet the thresholds for Class 3 non-hazardous waste. These wastes are often disposed of in permitted municipal landfills.

---

[33] Texas Cast Metals Association, Incorporated. *Beneficial Use of Foundry Sand in the State of Texas: A Cooperative Approach*, February 15, 1996.

[34] Texas Administrative Code, Title 30 – Environmental Quality, Part 1 – TCEQ, Chapter 335 – Industrial Solid Waste and Municipal Hazardous Waste (30 TAC 335).

[35] TCEQ. Publication RG-387, *An Environmental Guide for Texas Foundries*, Chapter 5, October 2001.

[36] TCEQ. Publication RG-22, *Guidelines for the Classification and Coding of Industrial and Hazardous Wastes*, April 2000, p. 1.

[37] This summary provides a general outline of the requirements a facility must meet to beneficially reuse foundry sand. These requirements may not apply for solid waste in other situations (e.g., disposal).

- **Class 3**. Class 3 wastes are considered the least threatening to human health and the environment. Class 3 waste is inert and essentially insoluble and includes such materials as brick, glass, plastics, and rubber. If essentially uncontaminated, these wastes are considered nonthreatening and can be accepted at all permitted landfills.

Non-hazardous foundry sand can also qualify as "non-waste" for beneficial reuse if it meets the following eight criteria for "recycling material:"

1. Each constituent in the recycling material must also normally be found in the raw material it is replacing. If not, it must not present an increased risk to human health, the environment, or waters of the state.

2. A legitimate market must exist for the recycling material as well as its products.

3. The recycling material must be managed and protected from loss, just as raw materials, ingredients, or products would be.

4. The quality of a product must not be degraded by replacing raw materials with recycling materials.

5. The recycling materials must be used without processing or changing the properties of the materials; or the recycling materials must be a necessary ingredient in a production process, and they must either meet or exceed the specifications of the raw materials being replaced without treatment or reclamation.

6. The recycling material must not be burned for energy recovery, used to produce a fuel, or be contained in a fuel.

7. The recycling material may be used as a product itself or to produce products as it is generated without treatment or reclamation.

8. During the calendar year (beginning January 1), a foundry must recycle at least 75 percent (by weight or volume) of the recycling material accumulated during the previous year.

Allowable Beneficial Reuses

Foundry sand that is considered "non-waste" according to 30 TAC 335.1 is immediately eligible for any beneficial reuse; it is not necessary to notify TCEQ about the sand or its use.

Non-hazardous waste (Classes 1, 2, and 3) is also eligible for reuse, but must meet additional requirements (discussed below).[38] According to TCEQ, some uses of foundry sand include:

- cement, brick, and asphalt manufacture;
- concrete – pipe and block, prestress, ready mix, precast, etc.;
- sand-blasting media and non-skid treatments;
- geotechnical fill – structural, drainage, top cover at landfills, liner material systems;
- flowable fill, subgrade fill, road base, etc.;
- paint filler; and
- steel production.

Constituent Concentration Thresholds

Leachate from non-hazardous waste must be evaluated for the presence of 135 constituents. Furthermore, for a waste to be a Class 3 waste, it must also be evaluated using a seven-day distilled water leachate test. The results of this test are compared to thresholds for 35 constituents, which are based on federal maximum contaminant levels (MCLs) and total dissolved solids. A subset of constituents and their thresholds for each type of leachate test is presented in Exhibit A-6.

Exhibit A-6

TEXAS' LEACHATE THRESHOLDS FOR NON-HAZARDOUS WASTE EVALUATIONS (in mg/L)

Constituent*	Maximum Leachable Concentrations to be Considered Non-hazardous	7-Day Distilled Water Leachate Test's MCLs: Class 3 only
Arsenic	1.80	0.05
Barium	100.0	1.0
Benzene	0.50	0.005
Beryllium	0.08	Not listed
Cadmium	0.50	0.005
Chromium	5.0	0.10
Lead	1.50	0.05
Mercury	0.20	0.002
Phenol	2,000	Not listed
Selenium	1.0	0.05
Silver	5.0	0.05

* The list of constituents is not comprehensive.

[38] If foundry sand that qualifies for Class 2 waste exceeds a total petroleum hydrocarbon threshold of 1,500 ppm, it is suitable for reuse only in asphalt.

Sampling and Testing Requirements

No testing is required for reuse of material that qualifies as non-waste. Non-hazardous waste (all classes) is subject to several testing requirements: (1) leachate testing (e.g., TCLP for metals and other possible toxic constituents); (2) totals analysis for total petroleum hydrocarbons (TPHs); and (3) verification of the absence of polychlorinated biphenyls (PCBs). Generally, sand must be retested when there is a change in the foundry process generating the waste sand.

Other Requirements

Generators of non-waste sand must maintain records on-site documenting the dates the sand was originally produced, when it was sent for reuse, how it is to be used, its composition and characteristics, where it is going for use, and why it is not a waste.

If classified as non-hazardous industrial waste, the sand and its proposed use or activity cannot result in discharges into or adjacent to surface waters, cause a nuisance, or endanger public health or welfare. Notification of the proposed sand use must be provided to TCEQ at least 90 days before the use or activity begins. Re-notification is necessary if the process generating the sand or its planned use changes significantly. Manifesting, annual reports, and waste receipt summaries are required only if TCEQ specifically requests them.

WEST VIRGINIA

The Office of Waste Management within West Virginia's Division of Environmental Protection (DEP) developed guidance specific to the beneficial use of "spent foundry sand (including molding sand and core sand) generated by metal casting foundries."[39] Beneficial reuse of foundry sand requires a plan approval from DEP. The plan must detail the intended use of the spent sand, set out a sampling and testing plan for the sand (e.g., total metals and TCLP analyses), and demonstrate that the waste and its intended use do not pose a threat to human and environmental welfare (e.g., through meeting threshold concentrations of constituents of concern and meeting isolation distance requirements).

Waste Classification System

DEP guidance on the beneficial use of spent foundry sand does not establish a waste classification system. Rather, it outlines a process for obtaining permission for use based on information characterizing the waste, its intended use, and a plan for managing the waste once it is used. All material must meet one set of leachate and total metals guidelines.

Allowable Beneficial Uses

West Virginia guidelines on beneficial use of spent foundry sand do not apply to wastes that are "Hazardous by Characteristic (as described in 40 CFR 261.24) or Listed Hazardous Wastes (described in 40 CFR 261.31, 261.32 and 261.33)." Allowed beneficial uses of spent foundry sand include:

- **Manufacturing Another Product**. Use as a raw material in manufacturing another final product, e.g., grout, cement, concrete, asphalt, roofing materials, plastics, paint, glass, fiberglass, ornamental ceramics, rock wool, mineral wool, brick, plaster, and other similar products.

- **Stabilization/Solidification of Other Wastes**. Use as a stabilization/ solidification agent for other wastes to be disposed of at an approved facility.

- **Anti-Skid Agent/Road Surface Preparation Material**. Use as an anti-skid material or road surface preparation material. Use must be consistent with WV Department of Highways or other applicable specifications.

- **Daily Cover of Landfills**. Use as a daily cover at municipal solid waste landfills, if all technical specifications are met for this intended use.

---

[39] WV DEP. *Spent Foundry Sand Beneficial Use Guidelines*. Effective date, June 1, 2000.

- **Protective Cover for Landfill Leachate Collection Service.** Use as a protective cover material located above the drainage layer of a municipal solid waste landfill, if all technical specifications are met for this intended use.

- **Structural Fill.** As an engineered use, i.e., as a building or equipment supportive base or foundation. This category does not include valley fills or filling of open pits from coal or industrial mining.

- **Pipe bedding.**

- **Roads and Parking Lots, Capped Embankment, Ground and Site Barriers.** Use as construction material (sub-base) for roads or parking lots; "capped embankment," where an embankment supports a roadway or other structure whose side slopes are covered with soil suitable for the growth of normal vegetation; and "ground and site barriers," i.e., capped embankments for use as ground or site barriers as long, low, narrow structures lying above the existing ground surface. These structures do not support roadways or other structures and are capped with 24 inches of vegetative cover over their entire surface (where applicable). All activities in this category must be performed under the supervision of a professional engineer or the WV Department of Highways.

Constituent Concentration Thresholds

The leachate thresholds (in mg/L) for beneficial use of spent sand, based on results of TCLP analysis, are as follows:

- Arsenic - 0.05
- Barium - 1.0
- Cadmium - 0.01
- Chromium - 0.05
- Lead - 0.05
- Mercury - 0.002
- Selenium - 0.01
- Silver - 0.05
- Cyanide - 0.6
- Fluoride - 12.0
- Phenol - 10.5

The total metals thresholds (in mg/L) for beneficial use of spent sand include:

- Copper - 1500
- Molybdenum - 18
- Nickel - 200
- Zinc - 2800

Sampling and Testing Requirements

Approved plans for reuse must contain a sampling and analysis plan (SAP). The SAP must be submitted to WV Office of Waste Management, Solid Waste Management Section (SWMS), for review prior to sample collection and testing. The laboratory and facility personnel use the approved SAP as a reference during all phases of sample collection and analysis. The following items are addressed in the SAP:

- sample methods (3 composites for each source, each from 6 to 12 discrete samples);
- toxicity testing and analysis (TCLP or variation thereof);
- total metals testing and analysis (including copper, molybdenum, nickel, and zinc);
- number of samples (three tests on each parameter);
- parameters (i.e., constituents of concern); and
- additional testing for continued beneficial use (i.e., minimum of annual testing) or when the production process or raw materials used in the production process change.

Other Requirements

Beneficial use of spent foundry sand does not require a permit. Reuse does, however, require plan approval from the SWMS.[40] The major plan items are described below:

- chemical and physical description of the waste (i.e., fully characterizing its composition and properties) and description of the manufacturing and production processes that generated the waste (e.g., including information on chemical constituents in all binders, coatings, or other chemicals used in the production process);
- description of the use location, including topography, soil type, floodplains, and ground- and surface-water locations;
- description of the method for processing and/or beneficial use; and
- permanent, written consent from the landowner of the reuse site giving the WV DEP permission to enter the land.

---

[40] SWMS provides approval or denial within 30 days upon receipt of a complete application. If an application is denied, SWMS provides reason(s) for denial.

In addition, beneficial use projects must meet general requirements, such as storage, maintenance, and runoff control requirements; isolation distance requirements (varying minimum distance from streams, drinking-water wells, floodplains, public or private water sources, and groundwater); use restrictions (e.g., prohibited from use as a valley fill material, to fill open pits from coal or other fills, or to level an area or bring an area to grade where the construction activity is not completed properly after the placement of the material); and public health and safety concerns.

WISCONSIN

Wisconsin's beneficial reuse program consists of a five-tiered system based on leachate and totals standards for all non-hazardous industrial by-products.[41] Within the overall program, Wisconsin has created a beneficial reuse characterization process that targets ferrous foundry sand waste. Once generators determine the category for an industrial by-product, they may pursue any of the reuse methods pre-approved for that category. In almost all cases generators must periodically recharacterize beneficially reused wastes, and in all cases they must submit an annual certification.

Waste Classification System

Wisconsin's waste classification system consists of standards for five categories of industrial by-products and appropriate uses for each category. Category 1 by-products may be reused in any of the 12 methods allowed by Wisconsin Department of Natural Resources (DNR), while Category 5 by-products are limited to four methods.

- **Category 1** includes by-products that meet the most stringent leachate and total elemental standards.
- **Category 2** includes by-products that meet leachate and totals standards that are generally less stringent than the Category 1 standards by an order of magnitude. In addition, Category 2 has standards for fewer constituents than Category 1.
- **Category 3** includes by-products that meet the same leachate standards as Category 2, but do not need to meet the Category 2 totals standards.
- **Category 4** includes by-products that meet leachate standards that are less stringent than the Category 2 and 3 standards by a factor of two to five. In addition, Category 4 has standards for fewer constituents than Categories 2 and 3.
- **Category 5** includes by-products that are non-hazardous but do not meet any of the standards for Categories 1 through 4.

Within its beneficial reuse regulations Wisconsin makes specific provisions for ferrous foundry excess system sand, ferrous foundry slag, and coal ash. Only a subset of the constituents included in Wisconsin's general beneficial reuse regulations are applicable when characterizing each of these specific waste types. Non-ferrous foundry sands must receive specific department approval under the general beneficial reuse regulations.

---

[41] Chapter NR 538, Wisconsin Administrative Code, December 1997, *Beneficial Use of Industrial Byproducts*; and Publ-WA-822-98, April 1998, *Guidance for the Beneficial Use of Industrial Byproducts*.

Allowable Beneficial Reuses

Wisconsin allows 12 methods of beneficial reuse, most of which are suitable for spent foundry sands, but does not allow landspreading. The Wisconsin DNR can be petitioned to allow additional reuses not specified in the regulations. The 12 types of reuse specified in the regulations are listed below (the categories that qualify for each reuse are listed in parentheses):

- raw material for manufacturing a product (1-5);
- waste stabilization/solidification (1-5);
- supplemental fuel source/energy recovery (1-5);
- landfill daily cover/internal structures (1-5);
- confined geotechnical fill, including commercial, industrial or institutional building sub-base; paved lot base, sub-base, and subgrade fill; paved roadway base, sub-base and subgrade fill; tank, vault, or tunnel abandonment; utility trench backfill; bridge abutment backfill; and slabjacking material (1-4);
- encapsulated transportation facility embankment (1-4);
- capped transportation facility embankment (1-3);
- unconfined geotechnical fill (1-3);
- unbonded surface course (1-2);
- bonded surface course (1-2);
- decorative stone (1-2);
- cold-weather road abrasive (1-2); and
- general beneficial use in accordance with Chapter NR 538 (1-2).

Constituent Concentration Thresholds

An industrial by-product must meet leachate standards to qualify for any of the categories, and for Categories 1 and 2, it must also meet total elemental standards. The standards for ferrous foundry sand for all categories, are presented in Exhibit A-7.

Exhibit A-7

Wisconsin's Waste Characterization Standards for Ferrous Foundry Sands

	Category 1		Category 2	Categories 2 and 3	Category 4
Parameter	**Total Elemental (mg/kg)**	**Leachate (mg/L)**	**Total Elemental (mg/kg)**	**Leachate Standard (mg/L)**	**Leachate Standard (mg/L)**
Aluminum		1.5		15	
Antimony	6.3	0.0012		0.012	
Arsenic	0.042	0.005	21	0.05	
Barium		0.4		4.0	10
Beryllium	0.014	0.0004	7	0.004	
Cadmium		0.0005		0.005	0.025
Chromium, Hex.	14.5				
Chromium, total		0.010		0.10	
Copper		0.130			
Total Cyanide		0.040			
Fluoride		0.8		8.0	
Iron		0.15		1.5	3
Lead		0.0015		0.015	0.075
Manganese		0.025		0.25	
Mercury		0.0002		0.002	0.01
Nickel		0.020			
Phenol		1.2		12	
Selenium		0.010		0.10	
Sulfate		125			
Thallium	1.3	0.0004			
Zinc		2.5			
Acenaphthene	900		x		
Acenaphthylene	8.8		x		
Anthracene	5000		x		
Benz(a)anthracene	0.088		44		
Benzo(a)pyrene	0.0088		4.4		
Benzo(b)fluoranthene	0.088		44		
Benzo(ghi)perylene	0.88		x		
Benzo(k)fluoranthene	0.88		x		
Chrysene	8.8		x		
Dibenz(ah)anthracene	0.0088		4.4		
Fluoranthene	600		x		
Fluorene	600		x		
Indeno(123-	0.088		44		
1-methyl naphthalene	8.8		x		
2-methyl naphthalene	8.8		x		
Naphthalene	600		x		
Phenanthrene	0.88		x		
Pyrene	500		x		
Total Polyaromatic Hydrocarbons - PAHs			100		

Sampling and Testing Requirements

All sampling and analysis must be performed using EPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, and the sample collection and testing should be representative of the waste. A composite sample may need to be collected from several locations or over a specific time period, and the sampling technique must be adequately documented.

The most recent TCLP leachate test and total elemental analysis are applicable for Categories 1 and 2. For Categories 3 and 4 only the TCLP test applies. A by-product qualifies as Category 5 by simply not being a hazardous waste.

If the reuse material is used or stored in quantities that exceed 1,000 cubic yards per year over the previous authorization period, the applicant must recharacterize beneficially reused wastes based on a schedule contingent upon the waste category,. Specifically, the required recharacterization frequency is: Category 1 - every year; Category 2 - once every 2 years; Category 3 - once every 3 years; Category 4 - once every 5 years; and Category 5 - only when there is a change in the process that generates the industrial by-product.

Other Requirements

Other requirements include the following:

- Applicants must submit initial and annual certifications that document how the waste was generated, past and future beneficial methods, the most recent characterization testing results, any problems encountered during the previous year, and any environmental monitoring data collected during the past year at the beneficial reuse location.

- Beneficial reuse cannot create nuisance conditions at the reuse location or at storage locations.

- Public notice and public participation requirements, depending on the volume of waste to be reused.

- For certain projects (confined or unconfined geotechnical fill and bonded or unbonded surface course) that will contain by-product volumes over set thresholds, written notification must be submitted to the Wisconsin DNR prior to initiating the project. For large transportation facility embankment projects (greater than 100,000 cubic yards), Wisconsin DNR concurrence must be obtained prior to initiating the project.

- Monitoring of leachate volumes is required for the fully encapsulated or capped transportation facility embankment uses, with chemical analysis of the leachate required if the volume exceeds certain thresholds.

- The beneficial reuse of industrial by-products is prohibited under various performance standards if any of the following will occur: (1) a significant adverse impact on wetlands; (2) a significant adverse impact on critical habitat areas; (3) a detrimental effect on any surface water; (4) a detrimental effect on ground water; (5) an excessive accumulation of explosive gases; or (6) the emissions of any hazardous air contaminant exceeding state limitations.

APPENDIX B

CASE STUDIES OF BENEFICIAL USES OF FOUNDRY SAND

Reuse of Foundry Sand in Soil Amendments – Ohio
Reuse of Foundry Sand in Highway Construction – Wisconsin
Reuse of Foundry Sand in Asphalt Production – Michigan
Reuse of Foundry Sand as Parking Lot Fill – West Virginia

October 2002

REUSE OF FOUNDRY SAND IN SOIL AMENDMENTS – OHIO

Description of Beneficial Reuse Activity

Kurtz Brothers, Incorporated, produces and sells landscape products, including compost, soil, and mulch. For the past 20 years Kurtz has collected sand from foundries in Ohio for use in a variety of soil blending products. Each of Kurtz's production facilities uses the same "recipes" for the company's blended soil products, which are based on the recommendations of the Ohio Agriculture Research and Development Center at Ohio State University.

The vast majority of the sand collected from foundries by Kurtz is generated by ferrous operations, with the remainder coming from aluminum casting operations. Of the approximately 20 foundries from which Kurtz hauls sand, the Ford Foundry in Brookpark, Ohio, has been Kurtz's largest and most consistent source since the two companies entered into a hauling arrangement in 1986. The Ford facility produces only ferrous castings and generates approximately 1,000 tons of used sand per day. This sand goes directly into holding tanks, from which it is collected by Kurtz for hauling to its facility in Groveport, Ohio. A small percentage of sand generated at the Ford facility, primarily from the core preparation room and floor sweepings, is disposed of in a landfill.

In 2001, Kurtz collected approximately 270,000 tons of sand: nearly 241,000 tons from the Ford foundry, and a combined total of 28,000 tons from other foundries. During the same year, Kurtz used approximately 238,000 tons of foundry sand in its products, including 77,240 tons in the production of 180,000 cubic yards of soil blends.[1] Kurtz sells its soil products to approximately 225 customers consisting primarily of garden centers/nurseries and landscapers.

Dugan's Garden Center is a typical customer of Kurtz Brothers. Dugan's began to carry blended soil products from Kurtz in the late 1980s and currently carries three Kurtz products: *Pro-Blend,* which is a primary topsoil product consisting of sand and organic materials; *Ultra*

[1] Besides the soil blend products, Kurtz Brothers used 130,000 tons of sand in structural fill, 12,000 tons in flowable fill, 12,000 tons in day cover and final cover at landfills, 5,000 tons in custom backfill, and 2,000 tons in traction control products. The difference in sand collected (270,000 tons) and sand used in products (238,000 tons) represents 32,000 tons of sand stored on-site for future reuse.

Compost, a biosolids-based compost; and another organic, leaf-based compost. In terms of volume, Dugan's purchases and in turn sells 2,200-2,500 cubic yards of *Pro-Blend* a year.

Relevant Regulatory Framework in Ohio

Ohio Beneficial Use Policy

The Ohio Environmental Protection Agency's (Ohio EPA's) Division of Surface Water issued Policy Number 400.007, "*Beneficial Use of Nontoxic Bottom Ash, Fly Ash and Spent Foundry Sand, and Other Exempt Waste*," on November 7, 1994. The policy was issued in response to the large number of requests regarding reuse of certain industrial by-products (including foundry sands) that had been handled on a case-by-case basis. In some cases, the policy allows reuse without prior notification. This applies to specific materials, types of beneficial reuse, and contaminant concentrations. In the case of reusing foundry sand as a soil blending product, this policy restricts the volume of foundry sand to 50 percent of a commercial soil product "where the product will be used for growth of trees or ornamentals (not including sod farms)," and the product cannot be applied to grazed pastures or home food gardens, or used for growing crops.

Specific Permitting/Regulatory Requirements for Kurtz Brothers

Ohio's waste classification system established in Policy 400.007 consists of four beneficial use categories. Unlike other states, Ohio's "categories" do not correspond solely to types of beneficial uses, concentration thresholds, or volumes of sand reused. Instead, each category represents a combination of these three characteristics (i.e., the beneficial reuse, concentration thresholds, and volume of sand reused). Ohio EPA allows the most flexibility under Category 1 and the least flexibility under Category 4. (Ohio's waste classification system established by Policy 400.007 is discussed in more detail in Appendix A.)

Under Policy 400.007, Kurtz Brothers received a Category 4 approval in 1996 to manage sand from the Ford Foundry for five years. The Category 4 approval allowed Kurtz to manufacture soil blending products consisting of up to 20 percent foundry sand, provided the sand met certain contaminant concentration thresholds. Kurtz also needed to receive Ohio EPA consent and notify Ohio EPA of the reuse at least 60 days prior to commencing the reuse project. The remaining sand used by Kurtz from other foundries qualifies as Category 1 under Policy 400.007, which means that neither notification of Ohio EPA nor Agency review is required prior to reuse.

On December 6, 2001, shortly before the original approval was to expire, Kurtz Brothers and Ohio EPA agreed on a Permit-To-Install (PTI), which gives Kurtz more flexibility in how it could use foundry sand from Ford, provided the sand and final soil amendment products meet more stringent concentration thresholds. Specifically, the PTI allows for unrestricted use of foundry sand in blended soil products "for general use marketing" in commercial, residential, or agricultural applications, as long as the volume of sand in products does not represent more than 50 percent of the total volume of product and the following conditions are met:

- **Annual testing by Ford** of the leachate from its sand using the Toxicity Characteristic Leaching Procedure (TCLP). The leachate cannot exceed Ohio's drinking water Primary Maximum Contaminant Levels, 10 times Ohio's Secondary Maximum Concentration Levels, or additional limits for lead and phenol. If Ford changes its manufacturing process or the materials used in production, it must test the leachate from the new process to verify that no applicable regulatory thresholds are exceeded.

- **Quarterly TCLP testing by Kurtz** of the final soil amendment products containing foundry sand. Blended soil amendments containing foundry sand must be monitored quarterly for nine metals, and must meet limits that are equivalent to twice the limits found in U.S. EPA's 503(c) sludge regulations for the "clean tier."[2]

- **Submission of an annual report** from Kurtz Brothers to Ohio EPA that includes at a minimum: (1) the results of the annual TCLP monitoring of the foundry sands; (2) the results of the quarterly total metals monitoring of the soil blends; (3) any "interferences" with the project (e.g., spills); and (4) the results of any research on foundry sand recycling conducted by, or for, Kurtz.

Product Performance

By many accounts, Kurtz's *Pro-Blend* topsoil is superior to other manufactured soils not made with foundry sand. In addition, the *Pro-Blend* topsoil and other Kurtz blended soils containing foundry sand are looser, less compact, more permeable, and easier to work with than the local topsoil, which has a relatively high clay content. Dugan's Garden Center first chose to carry, and has continued to carry, Kurtz's topsoil product because: (1) there was no other topsoil blend product on the market in the late 1980s; (2) the high quality of the product (Dugan's believes *Pro-Blend* continues to perform better than other topsoils); and (3) it has always been price-competitive (Dugan's sells the *Pro-Blend* topsoil product for $26 per cubic yard, and the two Kurtz Brothers compost products for $22 per cubic yard). Those interviewed for this case study were satisfied with the performance, engineering characteristics, and quality of final soil products containing foundry sand.

Ohio EPA is confident that its classification system and method for evaluating the reuse of foundry sand, which focus on determining an appropriate list of contaminants (such as metals, cyanide, fluoride, and phenols) for testing and establishing protective limits, provides ample environmental safeguards. This confidence is supported by the fact that representatives at Ohio EPA, Kurtz, Ford, and Dugan's are not aware of any environmental problems associated with reusing foundry sand for soil amendment, nor have they heard of any end users experiencing environmental problems from Kurtz's products containing foundry sand. Furthermore, Ohio EPA is generally not concerned with potential environmental hazards associated with the reuse

[2] *The Standards for the Use or Disposal of Sewage Sludge*, Title 40 of the Code of Federal Regulations, Part 503.

of non-hazardous foundry sand, and is not aware of any instances of environmental damage resulting from reusing foundry sand.

Economic and Operational Effects

Kurtz Brothers' Perspective

Kurtz Brothers charges a fee to foundries for hauling and processing their sand. Kurtz uses a four-tiered fee structure that is determined by the composition of the foundry sand, its anticipated final use, and the transportation distance. No additional capital investment was required on the part of Kurtz to begin collecting and processing foundry sand. Overall, Kurtz estimates its costs of manufacturing soil products with foundry sand to be similar to the costs of manufacturing soil products before Kurtz used this sand as a raw material.

The only barrier preventing Kurtz from using more foundry sand in its products is the increased transportation cost associated with extending the network of foundries from which they collect sand. To obtain sand from additional foundry customers, Kurtz would have to increase the hauling fee to a level that would not be competitive with landfill tipping fees.

Ford's Perspective

Without investing any additional capital, Ford has been able to realize several economic and operational benefits by sending its sand to Kurtz Brothers. These benefits are typical of foundries sending sand to Kurtz. Before the existing hauling arrangements, foundries would dispose of sand either in foundry-owned monofills or in off-site landfills. The tipping fees for off-site disposal were $15 per ton for non-hazardous waste in 1985 and have since ranged from a high of almost $30 per ton to the current $10 per ton. In the time Kurtz and Ford have maintained their hauling arrangement, Ford estimates that its cost for sand disposal has decreased by two-thirds.

Additionally, the change from landfilling to reuse eliminated Ford's dependence on the off-site landfill's having the daily capacity to accept Ford's full shipment of sand. In the past, Ford was forced to stockpile its sand for future disposal whenever the landfill reached its daily capacity. Capacity is not an issue now that Kurtz is responsible for hauling the sand from the foundry, which significantly streamlines the handling of the sand.

REUSE OF FOUNDRY SAND IN HIGHWAY CONSTRUCTION - ENCAPSULATED STRUCTURAL FILL – WISCONSIN

Description of Beneficial Reuse Activity

Waupaca Foundry's interest in the beneficial reuse of foundry sand began in the mid-1980s when it participated in a research study at the University of Wisconsin-Madison on the potential use of foundry sand in highway construction. Foundry sand from Waupaca and two other foundries was tested to identify any potential environmental impacts associated with contaminant levels in pore water and leachate. In 1990, this research was expanded into a pilot study at a state Department of Transportation (DOT) highway construction project, with Waupaca providing 15,000-20,000 tons of sand.

Currently Waupaca is under contract with the DOT to provide 80,000 tons of sand to be used as structural fill in constructing embankments for Highway 10 near the city of Waupaca. For a 10-month period beginning in 2001, all of Waupaca's foundry sand was hauled to a temporary staging location near the future highway site, in anticipation of summer 2002 construction activities. The nature of Waupaca's process allows the sand to be taken directly for use without any further screening or treatment. The embankment will be closely monitored with lysimeters to ensure that the volume of fluid leaching from it meets Wisconsin Department of Natural Resources (DNR) requirements. For any exceedance, Waupaca must provide an evaluation of the cause, as well as a chemical analysis of the fluid collected and a proposed response to reduce the excess leachate. DOT will place a clay cap over the fill, but no other precautions are required for the reuse of foundry sand as structural fill under existing DNR regulations.

Relevant Regulatory Framework in Wisconsin

Wisconsin provides for foundry sand reuse in the state Administrative Code Chapter NR 538, entitled "*Beneficial Use of Industrial By-products.*" This regulation establishes the performance standards and acceptable uses of industrial by-products, primarily ferrous foundry sand, ferrous foundry slag, and coal ash. (Standards for other materials are determined on a case-by-case basis in coordination with DNR.) Materials are classified by category, with

Category 1 being the most benign. The category determines which reuses are acceptable. Generally, materials classified in higher categories will require greater containment and will be acceptable for fewer reuses.

To qualify for Category 1 or 2 and be acceptable for a wide range of uses, materials must meet standards for both totals analysis (i.e., the composition of the material) and leachate tests (both quality and quantity). These materials must be tested frequently to ensure that they continue to meet the strict standards for these categories (e.g., to maintain a Category 1 classification, materials must be tested annually). To qualify for Category 3 or 4 and be acceptable for only a restricted set of applications, materials must meet only the leachate tests, with higher allowable contaminant levels. Category 3 and 4 materials also have less frequent testing requirements (e.g., once every five years for Category 4 materials). Materials also must be tested when there are significant changes in production processes. The sand from Waupaca has met Category 1 requirements for all constituents except arsenic and barium, which are at Category 2 levels.

The development of NR 538 was a joint effort among industry, DNR, DOT, and environmental groups, but was driven primarily by the foundry industry. This regulation substantially reduces the paperwork required for reuse of non-hazardous industrial waste (which is defined in NR 605). Under current regulations, only certain large projects (e.g., those involving more than 100,000 cubic yards of industrial by-products for embankment projects) require DNR concurrence to proceed. After completion of an embankment project, a site construction report must be submitted to the Bureau of Waste Management and to the local DNR field office, documenting the parameters of the project, soil testing data from specified sites during construction, and the institutional controls in place. A lysimeter, installed under the thickest portion of the embankment, is used to monitor the volume of the fluid leaching through the fill material. If more than 375 gallons of liquid is collected in a year, the company that provided the fill material must notify DNR and submit an evaluation of the reasons for the high volume, a chemical analysis of the leachate, and proposed action to reduce the volume of liquid leaching through the reused material.

Before finalizing the agreement with DOT for reusing its sand, Waupaca needed to obtain an initial certification. To receive its certification and a five-year exemption from hazardous waste regulations, Waupaca submitted an outline of its waste collection process and a characterization of the composition and physical properties of its sand. To maintain its certification for use in the construction of highway embankments, Waupaca must submit annual data on the production and use of its sand, including documentation that the sand continues to meet its classification category, plus a summary of any environmental monitoring results.

Product Performance

Foundry sand is well suited for use as structural fill in highway construction, performing on par with fresh borrow or fill material. In fact, in areas with clay-rich soils, foundry sand may even be superior to borrow. Foundry sand also is superior to fly ash, another industrial by-product sometimes considered for this type of use. Fly ash has a higher silt content than sand,

which makes it more difficult to use. In addition, fly ash tends to qualify as Category 3 or 4 material under Wisconsin's regulations, thus being subject to more restrictions on reuse.

The sand from the Waupaca foundry is very uniform and not significantly different from virgin sand, except for being finer and smoother in texture and black in color. According to DNR, the dark color of the sand limits its potential use. Aesthetic considerations prevent the use of black foundry sand in any application that does not involve some type of cover or encapsulation. Thus, foundry sand has not been used in the full range of allowable applications for Category 2 industrial by-products, such as cold weather road abrasives.

The Wisconsin DOT reports no problems with foundry sand use in its construction projects. Monitoring is conducted for all large projects, and all lysimeter levels have been within DNR specifications. These results are not surprising because of the high level of bentonite in the foundry sand, which greatly reduces its permeability.

Officials at DNR note the importance of documenting compliance (of both foundries and reuse projects) and annual reporting in advancing and expanding beneficial reuse. DNR receives many questions stemming from public concerns over the reuse of foundry sand. The most effective approach to addressing them is to justify DNR's determinations and positions with solid data.

Economic and Operational Effects

Waupaca Foundry's Perspective

For Waupaca Foundry, the costs of engaging in this beneficial reuse project with DOT are comparable to disposing of sand in the company-owned off-site monofill. When all transportation, monitoring, and maintenance costs are considered, the total cost of reuse is approximately $9.00-$9.25/ton. While this is somewhat higher than the up-front costs for monofilling the sand, there are future uncertain hidden costs associated with operating the monofill that tip the balance toward reuse. Waupaca estimates that the cost of reuse is similar to that of a commercial or municipal landfill, although some foundry sand customers receive cost breaks because the sand can be used as daily cover. Overall, though, the commercial or municipal landfill option is less preferable than either reuse or monofill disposal due to the potential future liability associated with disposing of sand in a landfill.

Waupaca's initial experiences with beneficial reuse of its foundry sands in the 1980s and early 1990s were not cost-effective. Facility processes used at the time required Waupaca to refine sand before reusing it. This step added significant cost to reusing the sand, making it more expensive than the monofill disposal option. However, general process improvements and increased reclamation of sand from baghouse ducts over the last 10 years at the facility have eliminated the need to process sand prior to reuse.

Transportation costs are a critical factor in the viability of reuse projects. For this project, 40 miles is about the maximum feasible transport distance, and then only if a local staging area is available. The staging area is needed because of differential trucking costs: for transporting sand to a state DOT construction site, a trucker must be paid at the "white sheet rate," which is

roughly $10/hour higher than the rate a private contractor typically charges. By establishing a staging area close to the construction site, the sand can be transported most of the distance by a private trucker at a lower rate, and subsequently carried the remaining short distance to the actual work site at the higher rate. The ability to establish a staging area for this project depended on finding a willing landowner with a suitable location that allowed for control of surface-water run-on and runoff. Waupaca and DNR credit Waupaca's contractor for working closely with the local government and general public through a series of public meetings to ensure support for the storage and reuse plan.

Department of Transportation's Perspective

Virgin fill materials are cheap and widely available in Wisconsin, which reduces the economic attractiveness of the beneficial reuse of industrial by-products. The costs associated with the regulatory requirements, even for Category 1 materials, mean that the transportation and processing costs for the foundry sand must be significantly lower than those for comparable virgin material. However, in areas that have very high clay content, foundry sand can be a superior product for fill.

Since the overall cost to DOT of reusing foundry sand is comparable to that of using virgin fill materials (i.e., the cost of purchasing reused fill material is lower, but this is offset by the additional cost for the lining), DOT staff note that they make an effort to reuse foundry sand and other industrial by-products to help reduce the need for disposal of these materials in landfills. This is consistent with Wisconsin's emphasis on the reuse of material in state projects.

The primary concern for DOT in undertaking a project that involves the use of foundry sand is whether the promised material will be available. In a past project, the foundry could provide only half of the material initially promised. In that case, DOT had to make up the difference with borrow, resulting in significant additional costs.

REUSE OF FOUNDRY SAND IN ASPHALT PRODUCTION – MICHIGAN

Description of Beneficial Reuse Activity

Resource Recovery Corporation (RRC) is located in the West Michigan town of Coopersville. RRC was created in 1990 to enhance the competitive advantage of West Michigan foundries through safe, dependable, and economic management of foundry residuals. RRC encourages participating foundries to increasingly employ sustainable business principles including reduction in use of materials entering the process residual stream, reclamation for internal reuse, and source separation to facilitate processing for beneficial use in other industries.

Beneficial use of foundry sand and other process residuals diverts materials from disposal in general refuse landfills and into other uses where they replace virgin resources. However, foundry sand is generally not suitable for reuse immediately after leaving foundry operations. To this end, RRC operates a sand processing facility where it reduces mold and core sand lumps, removes fines, recovers metallics, and screens the material to a specified particle size distribution. RRC also accumulates foundry slag at a site in nearby Muskegon, Michigan for crushing and subsequent use in the production of asphalt.

RRC is owned by 14 shareholder foundries who worked in cooperation with the Michigan Department of Environmental Quality (MDEQ) to establish the West Michigan operation. Much of the startup costs associated with the development of RRC were borne by the shareholding foundries and funded through the MDEQ Solid Waste Alternative Program grant program.

The sand processing equipment in Coopersville is located in a three acre Type III cell which is co-located within a 240 acre Allied Waste System Type II landfill. As a result, in addition to the processing capability, RRC also has access to long-term storage within the Type II landfill for future use and/or disposal of the residuals. Unusable residuals received by RRC, such as dusts and commingled wastes, are disposed of in Allied's landfill. The major focus of this project is the production of fine aggregate for use in asphalt manufacturing at a nearby Muskegon batch plant. This asphalt batch plant was upgraded specifically to use foundry sands and slags in the asphalt mix. Fine aggregate from the RRC facility is also sold to Allied for use as leachate collection system liner cover in the construction of new Type II landfill cells. The

entire operation is controlled from a free-standing facility located within the landfill boundary near the processing site.

In 2001, RRC sent over 31,000 tons of processed foundry aggregate to Asphalt Paving, Inc., (API) located in Muskegon, Michigan. API began to incorporate processed foundry aggregate into asphalt in 1997 and had utilized over 125,000 tons of this material through December 2001. Processed foundry sand and slag totally displaced virgin aggregate in several mix designs including, but not limited to, residential, industrial, private, and municipal projects including streets, parking lots, and tennis courts.

Regulatory Framework in Michigan

The beneficial use of non-hazardous foundry sand in Michigan is governed by Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and its administrative rules.

Among the intended purposes of the recent rule change was the reduction of land filling in Type II municipal solid waste landfills and Type III industrial waste landfills, and the facilitation of beneficial reuses. The rules provide a number of alternative means for qualifying foundry process residuals for beneficial reuse. Under Part 115 and the new administrative rules effective October 9, 1993, with respect to beneficial reuses, low-hazard industrial wastes - which include foundry sand and other residuals - that meet the inert criteria may be utilized in asphalt, concrete, as fill material, and in other uses without petitioning the director of the MDEQ for an inertness designation. According to Section 11506, of Part 115, slag or slag products directed to a slag processor or to a reuser of slag or slag products are not solid waste.

Foundry process residuals must meet the one in a million risk calculated criteria in order to be eligible for uncontained uses, such as fill material and soil blending. To be eligible for contained uses, such as asphalt, concrete, or flowable fill, the residuals must meet the low-hazard industrial waste criteria - ten percent of the hazardous waste regulatory levels or 10 times the inert criteria, whichever is higher. These determinations are made based on testing for a multitude of chemical parameters using specific detection limits.

While sub-rules allow for the self-implementing reuse of low-hazard industrial wastes used as aggregates, the burden of proof that the materials qualify as low hazard lies with the generator. It is also possible to petition the director to designate a solid waste as an inert material when it is used as a substitute for virgin material. Under sub-rule designation, the director can approve the petition if the material does not pose a threat to groundwater and the conditions of reuse will prohibit exposures that result in unacceptable risks, as defined by rule. Essentially this means that leachate concentrations (TCLP, SPLP, or other approved test procedures) from the waste materials cannot exceed that of background soil, method detection limits, or groundwater criteria; nor can total concentrations on a dry weight basis as the material is reused exceed allowable human direct contact criteria. The material cannot pose a greater hazard to human health and the environment during reuse than the virgin material it replaces when used as a raw material in manufactured products.

Product Performance

The processed foundry residuals produced by RRC have worked well as fine aggregate substitutes for the virgin quarried material in hot asphalt mix designs. The processed aggregate has also worked well as a substitute for virgin aggregate in leachate collection applications in municipal solid waste landfills. The proportion of foundry residuals utilized in asphalt varies widely by mix design and the application for which the asphalt is produced. As much as 37 percent sand and 23 percent slag have been utilized in some mix designs. Typical proportions for most asphalt applications are roughly 10 percent for sand and 15 percent for slag. In all cases, the processed foundry residuals used totally displaced virgin aggregate.

Economic and Operational Effects

RRC's and Foundries' Perspectives

RRC operates as a cooperative to reduce disposal costs for the foundry industry in West Michigan. While RRC is a for-profit consortium, the goal of the organization has been to reduce costs for foundries in an environmentally responsible manner rather than to develop into a highly profitable venture. Foundries benefit economically and environmentally due to the innovative and responsible handling of these residuals.

When RRC was founded in the early 1990's, local landfill tipping fees were increasing dramatically from approximately $3.00 per ton to over $20.00 per ton. Currently, shareholder and non-shareholder foundries pay approximately $1.50 to $13.00 per ton for reuse and/or disposal of their residuals. Transportation costs vary based on proximity and type of truck required to transport their materials. RRC receives sand from within a 90 mile radius; beyond this distance the costs of transportation become prohibitive.

At present, RRC is able to effectively market all of the foundry process residuals it produces. Despite this, RRC is always working to develop additional suitable and sustainable end uses in both high- and low-end applications for processed foundry residuals through research and development. RRC is especially interested in developing applications for foundry process fines and is also interested in working with the MDEQ to expand the list of accepted applications for these recyclable materials.

End User's Perspective

RRC markets processed foundry materials (processed sand and slag) for $2.00 to $4.00 per ton. The cost of comparable virgin materials is slightly more than RRC's processed materials in this naturally "sand rich" area. The consumers of this material utilize foundry process residuals because they meet their specifications, exhibit consistent uniformity, and provide a low cost recycled alternative as compared to virgin materials.

REUSE OF FOUNDRY SAND AS PARKING LOT FILL – WEST VIRGINIA

Description of Beneficial Reuse Activity

In West Virginia, HK Casting is one of the major foundries in a small local industry. Roughly a dozen casters operate in West Virginia, using a variety of metals and sands and servicing a wide mix of markets.

HK Casting, with 38 employees, casts about 10,000 tons of iron a day. The casting uses about 100 tons of sand per day. Eighty-five percent of the sand is reclaimed into the casting operation. The remaining sand (15 tons per day) goes into an overage area prior to disposal or external reuse. Currently, they reuse sand primarily as sub-base for parking lots. In the past several years, HK has used 21,000 tons of sand in this manner, providing material for new parking lots: one at the Weston Ford dealership located near the foundry, and a second at a local senior center. A third reuse project is planned in an additional parking lot at the Ford dealership.

HK Casting was a key player in working with the West Virginia Department of Environmental Protection (DEP) to establish a foundry sand beneficial reuse policy. With the assistance of West Virginia University, HK compiled information on reuse policies in other states and shared it with the DEP to help in developing the new state guidelines. According to DEP personnel, HK is the only foundry in West Virginia currently reusing sand under the agency's recently established guidelines.

Relevant Regulatory Framework in West Virginia

West Virginia instituted new foundry sand beneficial reuse guidelines in 2000. Each reuse project requires the submission of a reuse plan that includes the use, the use location, the amount of sand proposed for reuse, and a sampling and analysis plan. The DEP reviews the project and inspects the reuse site.

The guidelines require certain buffer distances to limit potential leaching of constituents from the fill material. The primary concerns are that the project must not be within a 100-year floodplain and that it must be sufficiently far from intermittent or perennial streams, ponds, wetlands, and drinking-water sources.

The sampling and analysis plan addresses the chemical analysis requirements, including initial and annual testing. The required chemical analyses (TCLP and total metals) specify thresholds for 13 elements and two compounds. The thresholds for metals evaluated by TCLP in the guidelines are set at one percent of the toxicity values for hazardous waste under RCRA (40 CFR 261.24). Total metals analysis is required for copper, molybdenum, nickel, and zinc. Before the foundry requests approval to undertake a reuse project, it must have a sand sampling and analysis plan for TCLP and total metals accepted by the DEP. TCLP and total metals analysis are required initially, and on an annual basis thereafter. The facility must keep records of the analyses for at least five years.

The West Virginia guidelines encourage waste minimization and internal reclamation over external beneficial reuse programs: "Generators of foundry sand should actively pursue and implement all feasible alternatives to reduce the volume and toxicity of such waste, as well as explore on-site recycling, or recovery, before evaluating potential beneficial uses of the material."[3] However, external beneficial reuse is preferable to disposal, and the guidelines specify eight categories of acceptable reuses. Numerous reuses are covered, including manufacture of a variety of new products, anti-skid material, structural fill, and sub-base or embankment fill. The guidelines also specify sand storage requirements, which include erosion and runoff control practices and siting. Also, storage is limited to one year, unless specific DEP approval is obtained.

For the parking lot projects, no additional testing is required at the site, except for initial verification of its suitability based on distances from water sources and ability for runoff and erosion control. While no specific leachate testing is required, the DEP does have the authority to inspect and monitor the reuse site any time before, during, or after a beneficial reuse project.

In discussing the regulation of used foundry sand, HK Casting emphasized the importance of requirements for testing sand and tracking its use. Such requirements ensure that the reuse program will remain viable and that it can be self-promoting, and enable state organizations and trade groups to demonstrate the advantages of beneficially reusing foundry sand.

Product Performance

HK Casting and Weston Ford view this endeavor as mutually beneficial. HK Casting arranged for all the testing and paperwork, and then transported the sand to the project site. Neither party charged any fees. Weston Ford reports that the material has met all specifications and requirements, and it has observed no adverse effects from reusing foundry sand as fill in its parking lot. The two parties plan to undertake a second project in 2002 on an adjacent site owned by Weston, if permitting issues unrelated to the foundry sand reuse are resolved. The West Virginia DEP has been satisfied with the results of both reuse projects that HK Casting has completed (the initial project at Weston Ford and the project at the senior center).

[3] West Virginia Spent Foundry Sand Beneficial Use Guidelines, Section I.

Economic and Operational Effects

HK Casting's Perspective

The incremental costs for processing sand are small. To prepare its foundry sand for reuse, HK Casting must screen for metals and break up any large lumps present in the sand. However, HK already uses the same processing steps for reclaiming sand within the foundry. In addition, no major changes were necessary for transporting the sand, because the foundry already owned a truck and loader.

In keeping with state requirements for beneficial reuse, HK tests its sand annually to verify that it meets the appropriate thresholds. Before reusing its sand, the state guidelines required HK Casting to conduct a TCLP analysis to certify that the sand was a non-hazardous waste for disposal. However, the state did not require a total metals analysis.

Overall, while HK has incurred some additional costs associated with more frequent testing and time spent on paperwork required for reuse, the cost savings associated with eliminating landfill fees for a portion of their foundry sand and lowering transportation costs have far outweighed these additional costs. Local landfill costs are approximately $30 per ton, and the landfill HK previously used is about 25 miles away. Their current reuse project is located about one mile from the foundry. The savings to HK in landfill fees alone total $630,000.

HK Casting's involvement in materials reuse in West Virginia began only two years ago, due to the lack of a state reuse policy before then. The owner of the facility has been involved in the foundry business for 45 years and has previously been engaged in reuse projects in other states where reuse was permitted. HK Casting is not expanding its reuse activities at this time, primarily due to a limited quantity of sand available on-site for reuse.

Weston Ford's Perspective

Weston Ford was unaware of the potential to reuse foundry sand prior to being contacted by HK Casting. Weston is very satisfied with its involvement in the reuse project, particularly since it received the materials for its parking lot construction free of charge. Otherwise, Weston would have needed to purchase new fill material.