



Foundry Sand Reuse in Minnesota

Best Practices & Regulatory Compliance

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3. Key Concepts and Definitions

What is Foundry Sand?

Foundry sand is a high-quality silica sand used by metal casting facilities to make molds for shaping molten metal into parts. After repeated use, the sand becomes "spent" and needs to be replaced — creating a large volume of by-product material.

What is Beneficial Reuse?

Beneficial reuse means finding safe, productive ways to repurpose industrial by-products (like foundry sand) instead of throwing them away. It protects the environment, saves natural resources, and cuts disposal costs. In Minnesota, beneficial reuse helps businesses lower expenses and communities build infrastructure more sustainably.

Examples of beneficial reuse for foundry sand include:

- Replacing mined sand in concrete or road base

- Using sand as daily cover at landfills
- Mixing into manufactured soils for landscaping

What is a TCLP Test?

TCLP stands for Toxicity Characteristic Leaching Procedure — a laboratory test required by the U.S. EPA to find out if a waste material might release harmful contaminants into groundwater.

How a TCLP test works:

- A sample of the material is soaked in a mild acidic solution that simulates rainwater or landfill conditions.
- Scientists measure what chemicals "leach out" of the sample into the fluid.
- If dangerous levels of metals (like lead) or chemicals are found, the material is classified as hazardous waste and must be managed under strict regulations.

If the material passes the TCLP test (meaning contaminants are below federal limits), it can be reused safely under environmental rules.

Why Should Readers Care About Foundry Sand Reuse?

- Environmental Protection: Reuse reduces waste sent to landfills and conserves natural sand resources, which are expensive and limited.
- Cost Savings: Foundries, cities, and contractors save money by reusing sand instead of buying new materials or paying high disposal fees.
- Public Safety: Proper testing (like TCLP) ensures that reused sand does not threaten drinking water, soil, or the environment.
- Economic Growth: Reuse projects create jobs, strengthen recycling industries, and make local construction and public works projects more affordable.

4. Regulatory Guidelines

Minnesota Pollution Control Agency (MPCA) Regulations

Standing Beneficial Use Determinations (SBUDs)

- Minnesota Rules Chapter 7035 outlines materials that are pre-approved for reuse through "Standing Beneficial Use Determinations" (SBUDs).
- As of now, spent foundry sand is not included in Minnesota's SBUD list.
- However, MPCA has proposed rule changes to consider expanding SBUDs to include additional industrial byproducts, including foundry sand.

Case-Specific Beneficial Use Determinations (BUDs)

- Any beneficial use of spent foundry sand in Minnesota currently requires a case-specific BUD under Minnesota Rule §7035.2860.
- MPCA approval is based on:
 - Adequate material characterization (chemical and physical analysis).
 - Proof that the sand substitutes for a commercially available product (e.g., aggregate, topsoil, sand).
 - Demonstration that the reuse will not adversely impact human health or the environment.
 - Use rates consistent with sound engineering or agronomic principles.

Approved Uses & Regulatory Expectations

- Foundry sand has been approved on a case-by-case basis for use in construction fill, asphalt blends, and landfill engineering applications.
- Each BUD application must typically include:
 - A Solid Waste Management Plan outlining how the material will be stored, handled, and applied.
 - Test data (e.g., TCLP, metals, organics) to confirm environmental safety. Annual reporting to MPCA regarding volumes used and application outcomes.

Federal EPA Guidelines

- The U.S. EPA encourages the beneficial reuse of spent foundry sand, particularly from iron, steel, and aluminum foundries.
- According to the 2014 EPA Risk Assessment, silica-based foundry sands can be safely reused in:
 - Soil blends
 - Road base
 - Construction materials
- The EPA defers regulatory oversight to state agencies such as MPCA for non-hazardous material management.

Local Ordinances

- Most cities and counties in Minnesota defer to the MPCA framework when it comes to the beneficial reuse of foundry sand.
- Permits or notifications may be required for specific applications, such as:
 - Land application of industrial by-products (including foundry sand): MPCA's general permit (MNG960000) covers some uses, but larger volumes (>10 dry tons/year) or uses near sensitive areas typically require individual permit—all subject to notification 30–180 days in advance

- Aggregate reuse in construction: Land-use departments may require local building, zoning, or stormwater permits, with nonmetallic mining permit rules (MNG490000) applying for sand processing or storage.
- However, when a reuse project:
- Complies with MPCA's solid-waste utilization rules (Ch. 7035), Operates under the general permit conditions, and
- Is properly characterized and documented,
- then additional local permitting or review is generally rare. Local jurisdictions typically require only routine notifications or confirmations rather than full permitting.

5. Reuse Applications and Minnesota Examples

Beneficial reuse of foundry sand in Minnesota takes multiple forms depending on material properties, project goals, and MPCA approvals. Real-world applications have been proven across industries, especially construction and landfill operations.

Common Beneficial Reuses

Reuse Application	Description	Minnesota Examples or Status
Road Base & Fill	Substitute for sand/aggregate in road subbase, embankments, and structural fill. Provides bulk and drainage.	Approved on a case-by-case basis by MPCA. Used in commercial fill and roadway subgrades. Requires testing and application-specific approval.
Cement & Concrete Production	Raw feedstock in Portland cement kilns (replaces virgin silica) or as fine aggregate in concrete and masonry products.	Not widespread in Minnesota. Potential exists; requires MPCA BUD and alignment with ASTM mix standards. Regional cement plants have shown interest in trials.
Landfill Uses	Daily cover, interim cover, or drainage layer material in liners and leachate systems.	MPCA has approved foundry sand for use as daily/interim cover and for geotechnical applications. Use typically requires TCLP data and a solid waste management plan.
Soil Amendment	Blend into topsoil, manufactured soil, or potting media to improve drainage. Typically limited to low-contaminant sands.	Not commonly practiced. Any use requires MPCA review and is likely limited to controlled pilot projects. Environmental safety documentation is essential.
Sandblasting Abrasive	Dry, granular sand used for surface blasting/cleaning in lieu of mined sand.	Permissible if the material meets purity and sizing specs. Must be free of heavy metals like lead and

Reuse Application	Description	Minnesota Examples or Status
		evaluated for reuse under industrial material safety standards.
Other Innovative Uses	Cattle bedding, snow/ice control, etc.	Subject to MPCA case-specific BUD. Few documented uses to date, but interest has been expressed by private industry and municipalities for snow control applications.

Minnesota Examples in Action

- **Case-Specific Roadway Fill Projects:** Foundry sand has been approved on a case-by-case basis by the MPCA for use as structural fill beneath industrial development sites and road subgrades. These projects demonstrate performance comparable to traditional aggregate when proper testing and documentation are provided.
- **Potential Cement Kiln Use:** While not currently widespread in Minnesota, regional cement facilities have expressed interest in foundry sand as a silica substitute. With MPCA approval and ASTM conformity, this could become a scalable application for compatible sands.
- **Landfill Daily and Intermediate Cover:** Select Minnesota landfills have accepted foundry sand for use as daily or intermediate cover when accompanied by TCLP testing and a solid waste utilization plan. This reduces demand for virgin soil and supports landfill operational efficiency.
- **University-Led Research and Soil Testing:** The University of Minnesota and other institutions have explored the potential of using foundry sand in soil blends, with a focus on drainage and structural characteristics. Widespread use is still limited and would require further MPCA review for approval.
- **Industrial Sandblasting Applications:** Some Minnesota metal fabrication facilities have evaluated spent core sand from foundries as an alternative blasting medium. Use is limited to sands that are clean, dry, and free of heavy metal contamination.

6. Environmental and Technical Considerations

Beneficial reuse of foundry sand requires careful understanding of material composition, contaminant risks, and environmental testing protocols to ensure safe and responsible outcomes.

Types of Foundry Sands

Ferrous Foundry Sands (Iron and Steel Castings):

- Typically high-purity silica sand bonded with clay (green sand) or chemical resins.
- Low in contaminants.

- EPA and Minnesota MPCA consider these the safest and most preferred for reuse.

Non-Ferrous Foundry Sands (Aluminum, Brass, Bronze Castings):

- Similar base sand but potential contamination from metal alloys.
- Brass/Bronze sands often contain elevated lead, requiring more stringent testing or stabilization before reuse.

Specialty Sands:

- Some foundries use olivine sands or other media; not covered under EPA's standard risk assessment for reuse.
- May alter soil pH or chemistry.

Contaminants of Concern

Contaminant	Source	Notes
Lead (Pb)	Brass/bronze alloys	Key concern; must not exceed TCLP leaching limit (5.0 mg/L).
Chromium (Cr)	Stainless steel alloys, pigments	Usually low and stable in ferrous foundries; not a major issue.
Phenols / Cresols	Phenolic resins (binder breakdown)	Organic compounds typically present in very low concentrations.
PAHs	Burnt sea coal or resin residues	Detected at very low levels; below environmental risk thresholds.
Dust / Free Silica	Physical hazard from dry sand	Requires dust suppression measures during handling to protect workers.
pH / Salinity	Binders, chemical additives	Some foundry sands have slightly alkaline pH, generally not problematic unless used directly in soils.

Importance of TCLP Testing

The Toxicity Characteristic Leaching Procedure (TCLP) is the industry-standard EPA test to determine whether foundry sand poses a leaching hazard to groundwater.

- Simulates landfill leachate conditions using an acetic acid solution.
- Measures 8 key metals (Lead, Arsenic, Cadmium, Chromium, etc.).
- Passing TCLP = Sand is classified as non-hazardous.
- Ferrous foundry sands in Minnesota typically pass TCLP easily.

If foundry sand fails TCLP (e.g., high lead from brass castings):

- It must be managed as hazardous waste, not reused without treatment.

Key for Minnesota Reuse: All sands used in landfill cover, road base, concrete, etc., must pass TCLP and have supporting documentation.

Environmental Behavior of Foundry Sand

- Heavy metals in ferrous sands are generally immobilized in the sand matrix.
- Organics (e.g., phenols, PAHs) are below actionable risk levels according to EPA risk assessments.
- Field studies show low leachability and no significant uptake into plants when used in soil amendments.

Conclusion: For properly characterized ferrous foundry sands, environmental risks are minimal — supporting broad beneficial reuse.

7. Funding, Grants, and Incentives

State-Level Incentives

Greater Minnesota Waste Reduction, Reuse & Recycling Grants

- Administered by the Minnesota Pollution Control Agency (MPCA).
- Provides competitive grants (\$50,000–\$250,000) for recycling, reuse, organics, and waste-reduction projects in Greater Minnesota.
- Requires a 25% cash match from the applicant.
- Eligible projects include foundry sand reuse infrastructure (e.g., screening, transport), pilot demonstrations, or site improvements.

MPCA Reuse & Recycling Grant Program (Metro Area)

- Offers roughly \$1 million annually for waste diversion projects.
- Focuses on supporting new reuse markets and recycling infrastructure.
- Foundry sand reuse may qualify if it diverts material from landfills or reduces need for virgin resources.

MnTAP (Minnesota Technical Assistance Program)

- Free program based at the University of Minnesota.
- Offers technical support for pollution prevention, waste reduction, and reuse strategies.
- Has worked with metalcasters on identifying beneficial reuse opportunities for foundry sand.

Federal-Level Opportunities

EPA Sustainable Materials Management Grants:

- Periodically available grants supporting innovative reuse/recycling projects.
- Can fund pilot projects, outreach campaigns, or infrastructure improvements related to foundry sand.

Federal Infrastructure and Recycling Funding (Infrastructure Investment and Jobs Act):

- Some grant programs are open to states and municipalities improving recycling or circular economy initiatives.
- Foundry sand reuse aligns with goals of waste reduction and sustainable construction.

FHWA / DOT Support:

- Federal Highway Administration promotes the use of recycled materials (including foundry sand) in road construction.
- Some research grants and technical support available for projects demonstrating new uses of industrial byproducts in infrastructure.

Local Opportunities

Local Government Partnerships:

- Counties and cities sometimes offer mini-grants or project cost-sharing for green construction and waste diversion projects.
- Example: County public works departments may help subsidize trucking costs if foundry sand is used in local road construction.
- Local governments (e.g., Olmsted, Winona counties) can apply for state-backed SCORE grants.

Public-Private Collaborations:

- Landfills may waive tipping fees for sand.
- Construction contractors may provide free transport in exchange for discounted material.
- Informal partnerships often unlock major savings without formal grant applications.

Summary Table: Key Funding and Incentive Programs

Program/Incentive	Type	Key Details	Impact for Foundry Sand Reuse
Greater MN Recycling Grants (MPCA)	State Grants	Competitive funding for recycling and reuse projects. Requires 25% match.	Can fund screening equipment, storage upgrades, or transport logistics.

Program/Incentive	Type	Key Details	Impact for Foundry Sand Reuse
MPCA Metro Recycling Grant Program	State Grants	~ \$1M/year available for material diversion and infrastructure in Twin Cities metro area.	Eligible for projects that reduce landfill use or create new end-use markets for foundry sand.
MnTAP Technical Assistance	Technical Assistance	Free university-backed support for pollution prevention and reuse feasibility.	Helps foundries assess sand safety, design systems, and prepare for beneficial use applications.
EPA / SWIFR / Federal Infrastructure Grants	Research / Demonstration	Federal support for circular economy and recycling innovation.	Can support pilot reuse systems, regional coordination, and facility upgrades.
Local SCORE & County Partnerships	Local/Regional Grants	County-level mini-grants and support for green construction or diversion initiatives.	Can offset costs of trucking, field trials, or public works collaboration.

8. Active Participants in Minnesota

Foundries (Generators of Spent Sand)

Dotson Iron Castings (Mankato, MN)

- A major gray and ductile iron foundry.
- Known for sustainability initiatives and sand reclamation systems.
- Has engaged with MnTAP on waste reduction and beneficial reuse analysis.

Midwest Metal Products (Winona, MN)

- Aluminum and non-ferrous foundry.
- Generates spent sand requiring special characterization.
- Candidate for pilot reuse projects through MPCA review.

Craft Pattern & Mold (Monticello, MN)

- Small precision foundry generating consistent sand waste streams.
- Potential partner for localized reuse initiatives with road contractors or landfills.

Grede Foundries (regional footprint, includes MN suppliers)

- Ships thousands of tons regionally, including from Minnesota operations.
- Has historically supplied sand to cement plants and road fill projects in neighboring states.

End Users (Consumers of Foundry Sand)

University of Minnesota – Civil Engineering Research Labs

- Conduct research on foundry sand leaching, soil integration, and construction performance.
- Partnered with MPCA to study sand as a viable fill and cover material.

Olmsted County Waste-to-Energy & Landfill Division (Rochester, MN)

- Potential end user for intermediate landfill cover and construction-grade fill.
- Participates in solid waste diversion pilot programs.

Dakota County Environmental Resources

- Supports sustainable construction and landfill engineering.
- Previously funded industrial byproduct studies and material diversion evaluations.

Road Builders & Municipal Contractors

- County and municipal construction departments (e.g., Hennepin, Ramsey) regularly source alternative fill.
- Many are open to foundry sand for trench backfill, subgrade, and non-structural fill—pending MPCA compliance.

Supporting Programs and Agencies

Minnesota Pollution Control Agency (MPCA)

- Oversees case-specific Beneficial Use Determinations (BUDs) under Chapter 7035.
- Administers recycling and waste diversion grants, including those for infrastructure and material reuse.
- Provides technical guidance, permitting support, and regulatory compliance oversight for foundry sand reuse.

MnTAP (Minnesota Technical Assistance Program)

- Based at the University of Minnesota.
- Offers free consulting services to foundries and manufacturers on pollution prevention and waste minimization.
- Has supported sand reuse evaluations and process improvements for Minnesota foundries.

Recycle Minnesota / Minnesota Waste Wise Foundation

- Statewide nonprofit that promotes business recycling and sustainable materials management.
- Offers guidance on material markets, environmental compliance, and circular economy practices.
- May assist foundries in locating end-users or developing reuse programs.

University of Minnesota – Civil & Environmental Engineering Department

- Conducts research on the performance and safety of industrial byproducts, including foundry sand.
- Supports life-cycle analysis (LCA), soil blending, and road construction integration studies.
- Potential partner for pilot programs and scientific validation of reuse pathways.

American Foundry Society (AFS) – Plains States Chapter

- Provides best practices, case studies, and regulatory updates relevant to foundry sand reuse.
- Members in Minnesota are actively engaged in industry-led environmental improvement initiatives.

Key Collaboration Insights

- Foundries provide reliable, consistent streams of spent sand suitable for reuse with proper characterization.
- Landfills and Infrastructure Projects serve as high-volume outlets for cover material, subgrade, or construction fill.
- Contractors and Municipalities create demand for cost-effective alternatives to mined sand and aggregate.
- MPCA, MnTAP, and University Partners ensure regulatory compliance, funding access, and credible environmental data.
- AFS and sustainability organizations help promote adoption, share success stories, and foster industry innovation.

The synergy between all these participants has made Minnesota a national leader in foundry sand beneficial reuse.

9. Success Story Highlights

Success Story 1: Dotson Iron Castings & MnTAP Collaboration

- Dotson Iron Castings (Mankato, MN) partnered with MnTAP to evaluate waste stream efficiency and opportunities for beneficial reuse.

- Identified consistent, high-quality sand output suitable for landfill cover or engineered fill.
- Resulted in improved internal sand handling and foundation for future BUD applications.

Success Story 2: University of Minnesota – Foundry Sand LCA Study

- Civil & Environmental Engineering Department conducted a life cycle assessment (LCA) of foundry sand reuse scenarios.
- Demonstrated environmental benefits including reduced greenhouse gas emissions and lower raw material consumption.
- Supported MPCA's review of beneficial use applications with scientifically backed data.

Success Story 3: Regional Fill Project Pilot – SE Minnesota

- A small foundry in Southeastern Minnesota worked with a local contractor and county public works to test spent sand as subbase fill.
- Sand passed TCLP testing and performed well structurally.
- Showcased the value of informal public-private collaboration for cost-effective material reuse.

10. Clear Business Case Summary

Why Foundries Should Reuse Sand:

- Save \$30–\$50 per ton vs. landfill disposal costs.
- Avoid environmental liability.
- Improve sustainability reporting for customers and regulators.

Why Contractors Should Reuse Sand:

- Get free or discounted sand for construction fill.
- Improve project bids by lowering material costs.

Why Landfills Should Accept Foundry Sand:

- Secure free cover material.
- Reduce operating costs.
- Increase daily cover efficiency.

11. Risk Management Overview

Beneficial reuse of foundry sand carries significant economic and environmental benefits, but participants must manage risk carefully to ensure compliance and protect their businesses.

Best Practices

- **Testing:** All sand must pass a current TCLP test (recommended updated annually or if process changes).
- **Documentation:** Keep certificates of analysis (CoA), TCLP results, and shipping records for at least five years.
- **Written Agreements:** Always establish written contracts with receiving facilities (landfills, cement plants, contractors) outlining responsibilities and confirming approved uses.
- **Site-Specific Approvals:** For new or unusual uses not covered under Minnesota's universal approvals, seek MPCA Beneficial Use Determination (BUD) or documented exemption.
- **Insurance:** Verify liability coverage, and ensure your insurer understands your beneficial reuse activities.

ARS Support: ARS can assist participants in setting up compliance systems, testing protocols, and document templates to minimize legal risk.

12. Step-by-Step Workflow for Foundries

Simple Process to Start Foundry Sand Reuse:

- **Test:**
 - Conduct TCLP testing on representative sand samples through an accredited laboratory.
 - Confirm results meet Minnesota MPCA non-hazardous thresholds.
- **Document:**
 - Save all lab results, including full reports and summary sheets.
- **Partner:**
 - Contact ARS to match your material to a reuse project (landfill, cement, construction).
- **Agreement:**
 - Sign a beneficial reuse agreement or memo of understanding.
- **Ship:**
 - Begin shipping sand as needed.

- Label loads clearly and maintain load-out logs.
- Monitor:
- If your production process changes (e.g., alloy change, new binder), re-test your sand.
- Maintain communication with ARS and receiving partners.

Result: Compliance, savings, and sustainability without added operational headaches.

13. Real Cost Savings Example

Why Reuse Makes Financial Sense:

- Landfill Disposal Costs:
- Disposal fee: ~\$70-\$150/ton
- Landfill surcharge: +\$4.25/ton
- Total = ~\$74.25-\$154.25/ton to landfill
- Beneficial Reuse Costs:
- Transportation only: ~\$10-\$75/ton (varies by distance)

Savings Calculation:

If your foundry produces 1,000 tons/year:

Landfill cost: 1,000 tons x \$49.25 = \$49,250

Reuse transport cost (avg \$15/ton): 1,000 tons x \$15 = \$15,000

Total annual savings = ~\$34,250

Multiply this by 5–10 years and the impact becomes massive.

15. General FAQ & Landfill-Specific FAQ

Q: Does foundry sand affect landfill leachate or groundwater?

A: No. Studies from the EPA, USDA, and other research groups confirm that properly tested silica-based ferrous foundry sands do not contribute to hazardous leachate or groundwater contamination when used in landfills.

Q: Is foundry sand considered "cover material" for daily cover compliance?

A: Yes. MPCA has approved foundry sand as daily or intermediate cover on a case-by-case basis. Typically used as a 50/50 mix with soil, subject to documentation and TCLP results.

Q: Do we need special equipment to handle foundry sand?

A: No. Foundry sand can be handled with standard landfill equipment, such as bulldozers, front-end loaders, and compactors.

Q: How do we document use to maintain compliance or secure local incentives?

A: Maintain load logs, cover layer tracking, and any required MPCA reporting. Templates are available from MnTAP or your regional landfill regulatory contact.

Q: What if sand chemistry changes?

A: Periodic re-testing is recommended, particularly when the foundry changes raw materials, casting metals, or binder systems.

16. References

- EPA - Foundry Sand Reuse Toolkit → EPA Toolkit for Developing Beneficial Reuse Programs for Foundry Sand (archived)
- AFS (American Foundry Society) Beneficial Reuse Guides and Case Studies → American Foundry Society Reuse Resources
- EPA Archives - Beneficial Reuse of Foundry Sand PDF → EPA Archive - Foundry Sand Beneficial Reuse PDF
- USDA Agricultural Research Service (ARS) Contributions → Referenced in EPA risk assessments and soil-related environmental studies.
- ScienceDirect Research - Waste Foundry Sand Leachate Characteristics → Waste Foundry Sand: Leachate Study - ScienceDirect
- MDPI Research on Environmental Aspects of Foundry Sand Reuse → Reuse or Disposal of Waste Foundry Sand: MDPI Research Article
- Pollution Prevention Challenge - Amerex Defense Environmental Initiatives → Pollution Prevention Challenge Awards
- Grede Foundries Sustainability Reports and Waste Management Presentations → Grede Sustainability Reports
- EPA - Sustainable Materials Management Program (SMM) Overview → EPA SMM Program
- Federal Infrastructure and Jobs Act (IIJA) Recycling Grants → Infrastructure Investment and Jobs Act - Recycling Grants
- Minnesota Pollution Control Agency (MPCA) – Solid Waste Utilization Rules → MPCA Solid Waste Rules – Minnesota Administrative Rules Chapter 7035
- MPCA Website
- University of Minnesota – Civil Engineering Foundry Sand Research → Foundry Sand Source Reduction Options: Life Cycle Assessment (ResearchGate)
- American Foundry Society (AFS) – Plains States Chapter → American Foundry Society Regional Chapters
- Recycle Minnesota (Minnesota Waste Wise Foundation) → Recycle Minnesota – Waste Wise Business Assistance
- EPA – Beneficial Uses of Spent Foundry Sands → EPA Beneficial Uses of Spent Foundry Sands

- EPA – Risk Assessment of Spent Foundry Sands in Soil-Related Applications (2014) → EPA Risk Assessment Final Report PDF
- EPA – Sustainable Materials Management (SMM) Program Overview → EPA SMM Program
- Federal Infrastructure Investment and Jobs Act (IIJA) – Recycling and Waste Grants → Infrastructure Investment and Jobs Act – Recycling Grants
- USDA/NRCS – Soil and Water Program Technical Support → USDA Technical Resources – Soil and Waste Management