Characteristics of Recycled Glass and End Use

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SANBORN HEAD

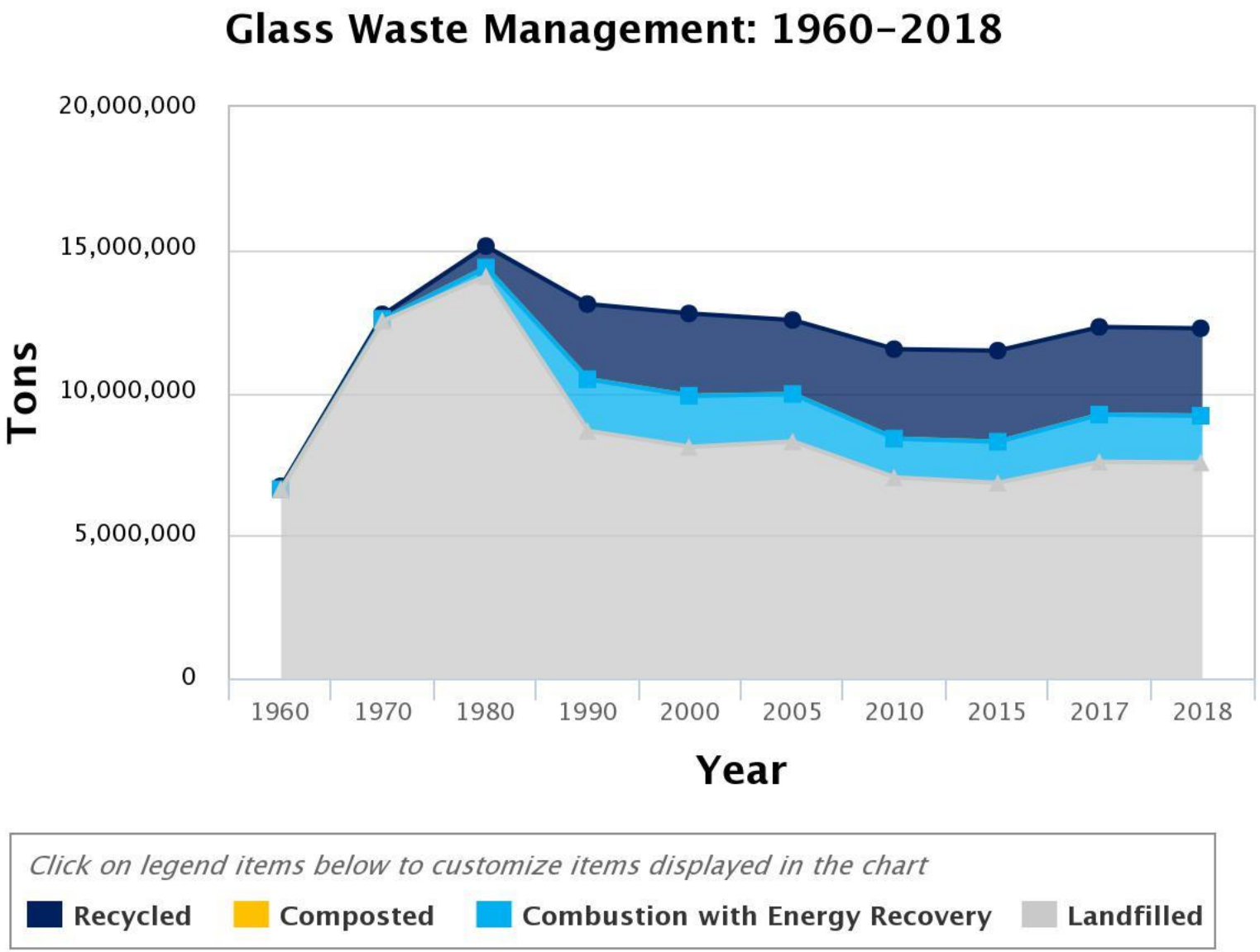
ISSUE

Hundreds of tons of waste glass is produced daily, and glass is essentially 100% recyclable

What is waste glass?

How can it be used?

Perspective



From: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/glass-material-specific-data

What should we talk about?

- What is waste glass and glass recycling?

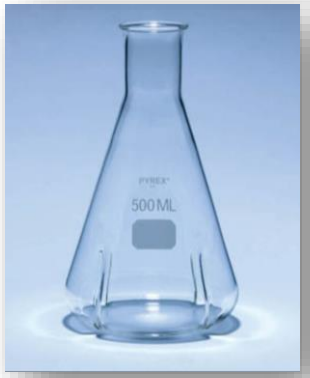
- Waste glass applications
  - Processed Glass Aggregate (PGA)
  - Landfill cover/gas collection systems
  - Concrete / Paving Blocks
  - Surfaces
  - Light Weight Foamed Glass Aggregate

Types of Glass

- **Soda-lime glass**

- Lead glass

- Borosilicate glass



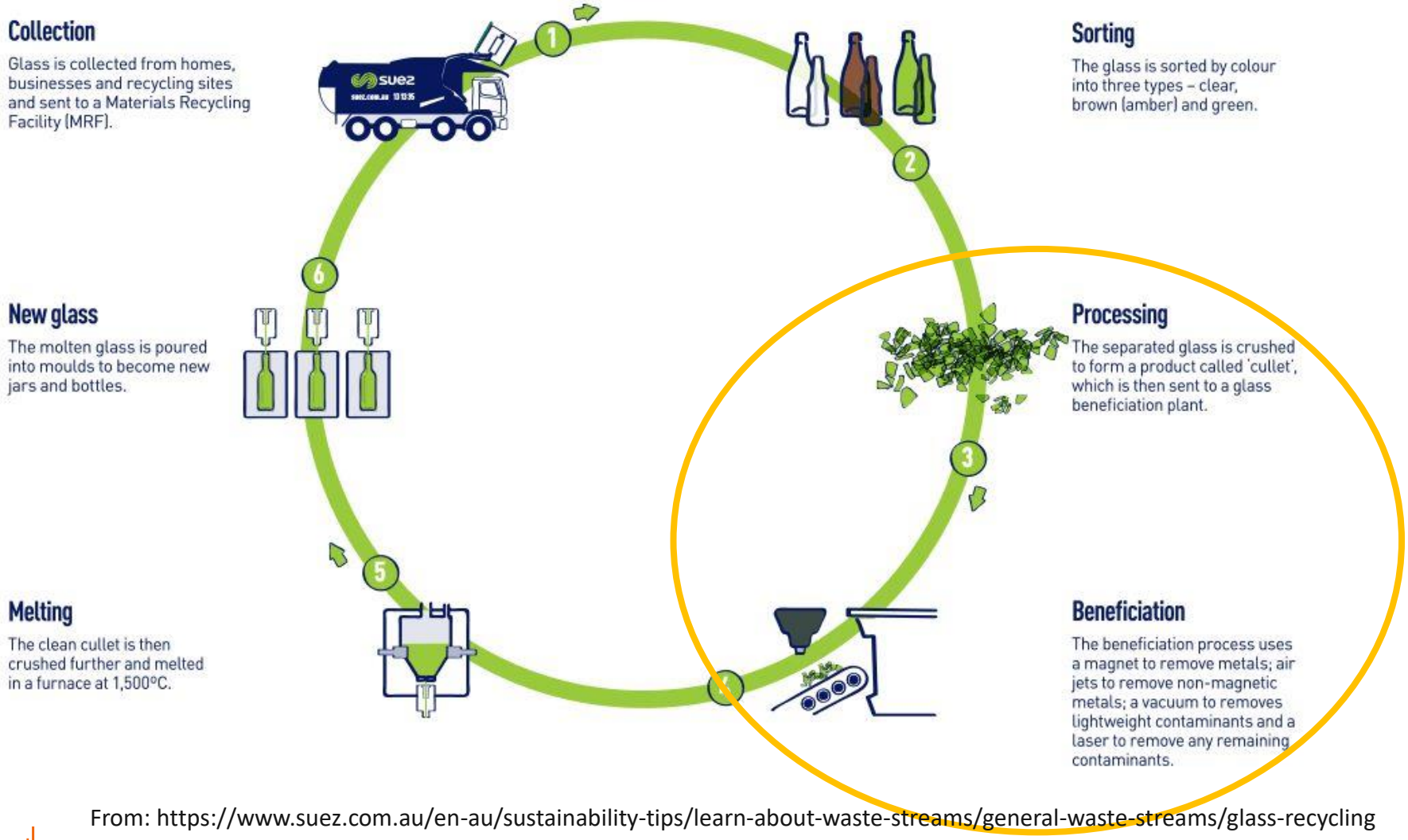
- Aluminosilicate glass

- Ninety-six percent silica glass

- Fused silica glass

From: https://www.cmog.org/article/types-glass

Cycle of Glass Recycling



From: https://www.suez.com.au/en-au/sustainability-tips/learn-about-waste-streams/general-waste-streams/glass-recycling

Waste Glass

- Glass Cullet
- Crushed Glass
- Recycled Crushed Glass
- Colors:
  - Clear
  - Brown
  - Green
  - Blue

Cycle of Glass Recycling

From: https://www.suez.com.au/en-au/sustainability-tips/learn-about-waste-streams/general-waste-streams/glass-recycling

Applications

- Processed Glass Aggregate (PGA)
- Landfill cover/gas collection system
- Concrete / Paving Blocks
- Surfaces
- Foamed glass aggregate
- Other Uses

Processed Glass Aggregate

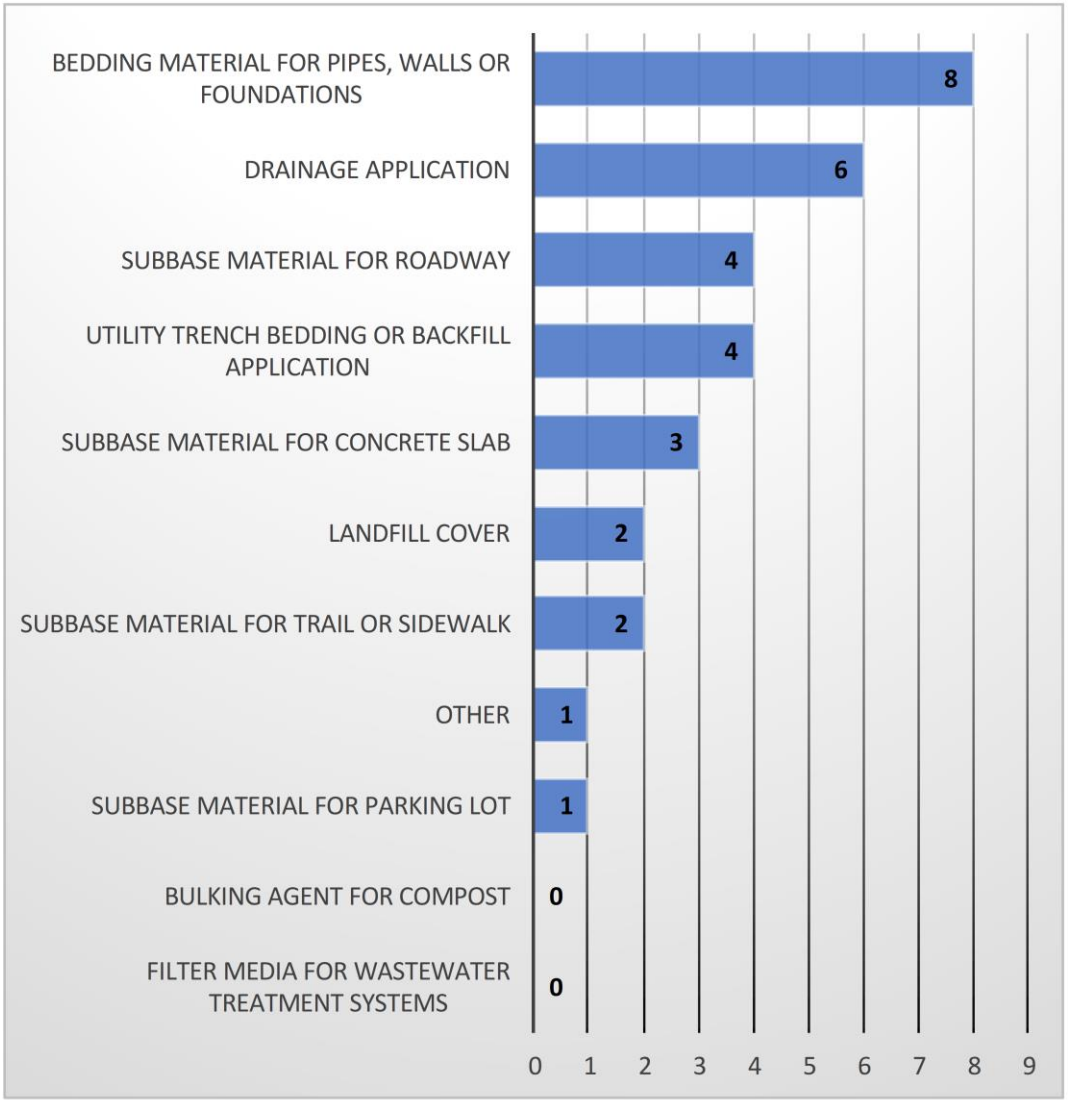
- Requires no color separation
- Suitable for use in construction industry to replace sand and gravel aggregates
- Compacts more tightly and sheds water better than sand
- Frost resistant

Processed Glass Aggregate

NORTHEAST RESOURCE RECOVERY ASSOCIATION

Northeast Resource Recovery Association (NRRA), June 2020 Survey

https://www.nrrarecycles.org/



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Northeast Resource Recovery Association
(603) 736-4401; www.nrrarecycles.org

Summary of Specifications and Approved Uses of Processed Glass Aggregate In New England - Environmental and Transportation Agencies

State	Environmental Agency - Gradation and Contamination Requirements	Environmental Agency - Approved Uses	Transportation Agency - Gradation and Contamination Requirements	Transportation Agency - Approved Uses	Mandatory Glass Recycling*
	Governs municipal and private use, including in municipal and private roads		Governs state use, including in state highways		
MA	• 100% of PGA must pass 3/8" sieve • PGA must consist of clean mixed color cullet with a maximum residual content (i.e., food, paper, etc.) of 5% by volume • No glass products other than food or beverage containers (i.e., fluorescent lights, video screens, windowpanes, etc.)	• Subgrade construction applications • Subsoil drainage systems • Substitute for conventional aggregate in asphalt or concrete • Daily cover	• 100% of PGA must pass 3/8" sieve • Maximum of 5% mass of the material may be produced from china dishes, ceramics, plate glass or other glass products • Allowed at a maximum addition rate of 10% by mass provided any subbase material will not be exposed • The material shall consist of recycled glass food or beverage containers free of debris such as paper, metals, fabrics, toxins, clay or loam	• Structural fill • Subbase material for roads	**Yes**
NH	• 100% of PGA shall pass a 1" sieve	• Subbase material for roads, bedding material for pipes and fill around retaining walls and foundations • Shall not be applied to ground surface and left uncovered as a final application; not approved as general fill • If used in public works application, must meet specifications of town or governmental unit using it • If used in private application, must meet specifications as determined by professional engineer or architect licensed in NH	• 100% of PGA must pass 3/8" sieve • Up to 20% PGA may be used to replace road base gravel (20% PGA/80% gravel mix) • Glass cullet shall meet requirements of AASHTO M318	• Glass cullet base course blends shall be capped with standard specification base course materials before the traveling public can drive over the material • Drainage • Pipe bedding • Structural fill • Subbase material for roads	**No**
VT	• 95% of the material shall pass a 1" (25.0mm) sieve • Not more than 3% of the material passing the No. 4 (4.75mm) sieve shall pass a No. 200 (0.075mm) sieve • Material shall contain 5% or less by mass china dishes, ceramics or plate glass • Material shall be less than 1% screw tops, plastic cap rings, or other contaminants	• Base course, subbase layer and embankments for roadway, trails, parking lots and sidewalk applications • Utility trench bedding and backfill applications • Drainage applications • Filter media for wastewater treatment systems • Landfill cover • Bulking agent for compost	• 95% of the material shall pass a 1-inch (25.0 mm) sieve • Not more than 3% of the material passing the No. 4 (4.75 mm) sieve shall pass a No. 200 (0.075 mm) sieve • Materials used to produce PGA shall consist of recycled glass food or beverage containers • Small amounts (less than 5% total) of china dishes, ceramics, plate (window or mirror) glass, or other glass products allowed in PGA • PGA material shall not contain more than trace amounts of screw tops, plastic cap rings, or other contaminants • Amounts of contaminants greater than 1% by weight shall be grounds for rejection of the entire PGA batch	• Structural fill • Subbase material for roads • Drainage • PGA subbase blends must be approved for use on the Project by the Engineer in writing prior to being placed on a Project. In-place blending of PGA with other materials is not permitted	**Yes**

https://www.nrrarecycles.org/sites/default/files/uploads/resource-documents/pga_by_state_new_england_7.27.20_1.pdf

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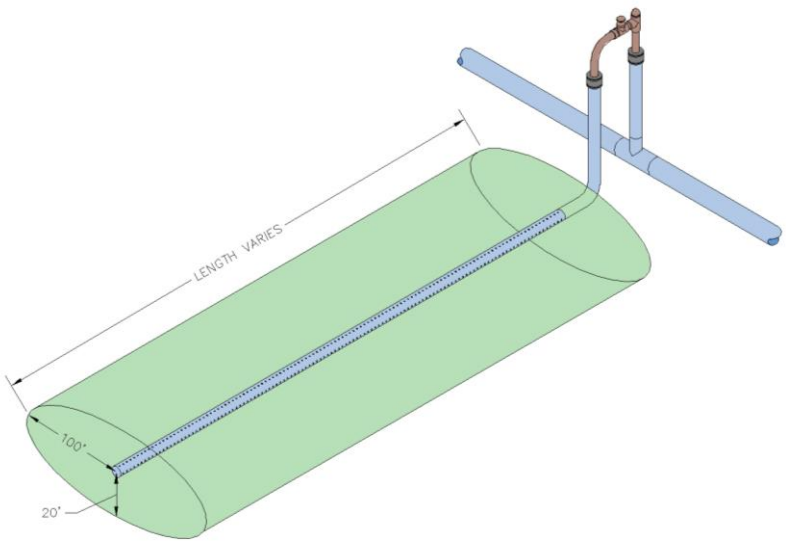
	Governs municipal and private use, including in municipal and private roads		Governs state use, including in state highways		
CT	• Crushed recycled glass may include glass food or beverage containers with less than 5%, by volume, of other solid waste material e.g. plastic, metal or paper • Has been combined by processing source-separated recyclable solid waste at an intermediary processing facility • Cannot be marked as cullet for remelt • Must have components that measure not greater than 3/8" • Must be virtually inert	• Landfill cover • Fill material including aggregate for asphalt or concrete or any other subgrade construction application in which the glass would serve as a substitute for sand or stone aggregate • Glass material may not constitute greater than 10% by volume of clean fill	• If glass is used in reclaimed waste, its individual particles shall be no larger than 1 inch and shall be thoroughly mixed with other embankment materials such that its content anywhere in the embankment shall not exceed 25% by weight • Stockpiled reclaimed waste material containing no more than 25% of glass by weight and no more than 2% by weight of asphalt cement may be used for part or all borrow requirements • If glass is used in bituminous concrete materials, crushed recycled container glass (CRCG) must: (1) not exceed 5% by weight of total aggregate; (2) contain no more than 1% by weight of contaminants such as paper, plastic and metal; and (3) 100% must be crushed to 3/8 of an inch or less	• Embankment material as reclaimed waste • To meet borrow requirements • May be used in bituminous concrete mixtures for pavement subbase and base courses • Engineer approval required	**Yes**
ME	• No state specifications for PGA	• NA	• No state specifications for PGA	• NA	**No**
RI	• No State specifications for PGA	• NA	• No state specifications for PGA	• NA	**Yes**

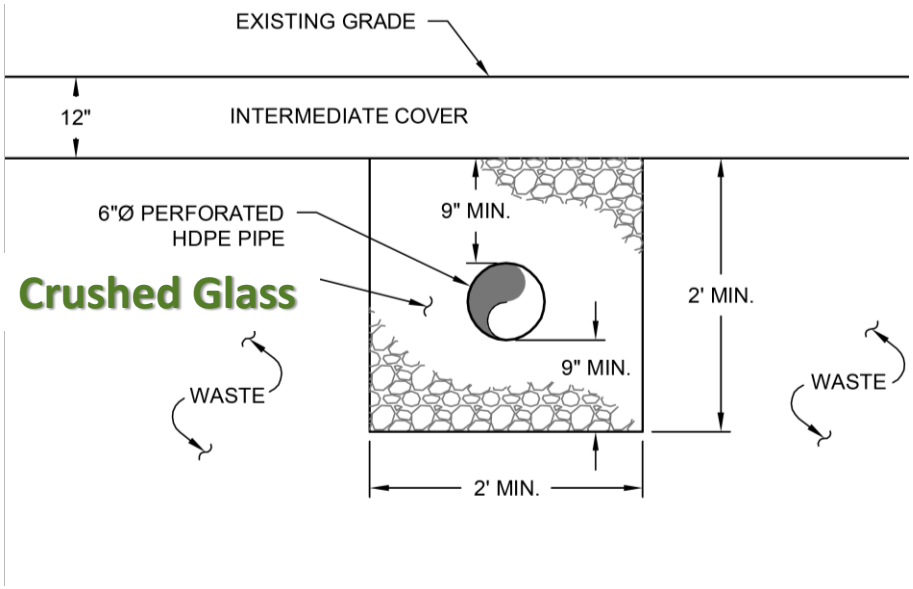
AASHTO M318 - Standard Specification for Glass Cullet Use for Soil-Aggregate Base Course

https://www.nrrarecycles.org/sites/default/files/uploads/resource-documents/pga_by_state_new_england_7.27.20_1.pdf

Landfill cover / gas collection system

- Replace cover soils
- Replace crushed stone in landfill gas collection trench





Concrete/Paving Blocks

- Waste glass can be used as the aggregate or to replace Portland cement (powder)

- Effects of glass on concrete properties depend on glass particle size, percentage, and color

Concrete/Paving Blocks

- Shape of crushed glass can impact workability due to mechanical interlocking of glass particles
- Appropriate use of glass can improve flowability and mechanical strength of concrete
- Using glass can improve permeability and freezing-thawing resistance of concrete
- Reducing glass particle size is effective in suppressing ASR expansion
- Thermal conductivity less than 1/3 of normal concrete

Glass Recycled Surfaces

Countertops

Mulch

https://glassrecycled.com/

Foamed Glass Aggregate

- Produced from 100% post-consumer recycled glass
- 85-90% lighter than quarried aggregates
- Up to 100 cy per truckload
- Uses include:
  - Embankments
  - Retaining walls
  - Roadways
  - Utilities
  - Foundation walls & slabs
  - Green roofs

Foamed Glass Aggregate

- Acts as both a drainage layer and thermal insulation (high R value)
- High Friction Angle (up to 45°)
- Prevents Frost Heave
- Easily Compacted

Other Uses

- Blast Media
- Fiberglass
- Highway Bead
- Sandpaper
- Fire suppressant
- Foam Insulation

Questions?

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