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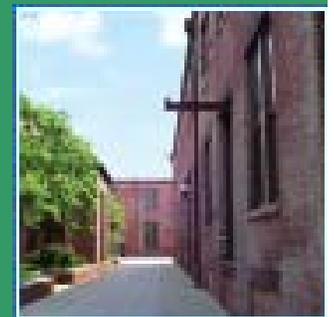
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C&D Materials Reuse and Recycling

Kimberly Cochran, PhD
US EPA Office of Solid Waste

*RCC Web Academy
February 21, 2008*

Building for the *Future* By Recycling Industrial
Materials



C&D Materials

- Concrete
- Asphalt pavement
- Wood
- Drywall
- Asphalt Shingles
- Metal
- Cardboard
- Plastics
- Insulation
- Tile
- Carpet
- Cabinetry
- Fixtures

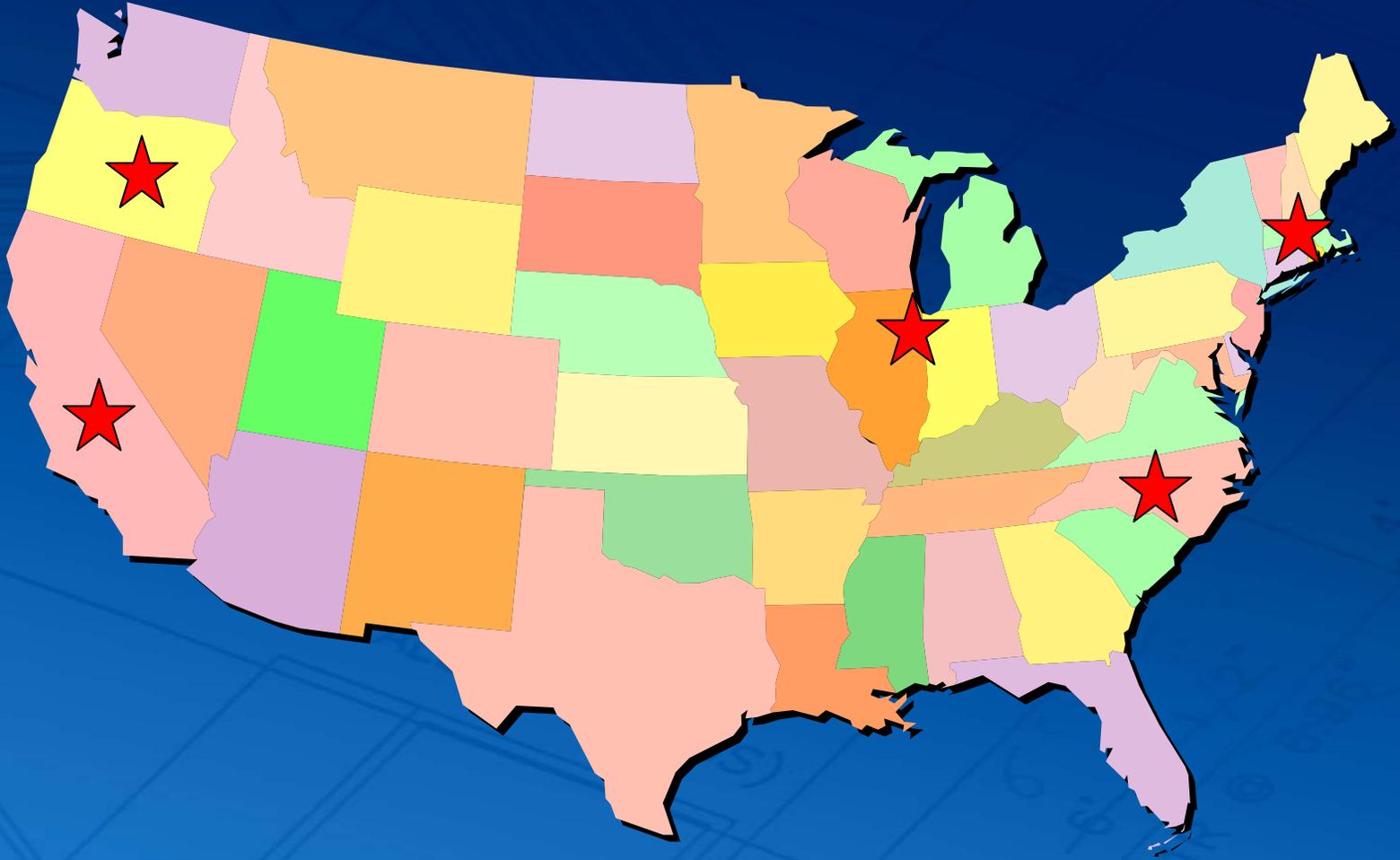
Why reuse/recycle these materials?

- Because they
 - Can substitute virgin materials AND save energy, time, and money
 - Perform as well or better than virgin materials
- To conserve landfill space.
- To capture valuable materials that would otherwise be lost.
- Because recycling/reusing can mean points for green building certification.

Other Factors Influencing C&D Materials Reuse and Recycling

- Increases in fuel prices
- Green building initiatives
- Efforts to reduce GHG emissions
- General difficulty to site landfills
- Hydrogen sulfide problems at landfills

New C&D Materials Recycling & Reuse Regulations/Ordinances



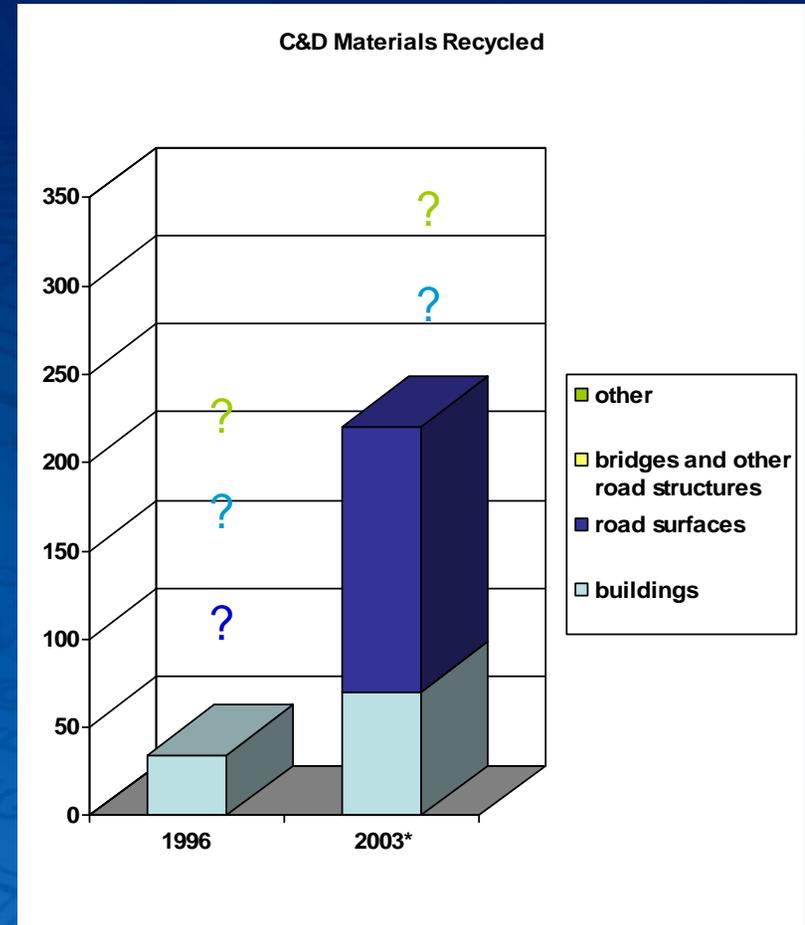
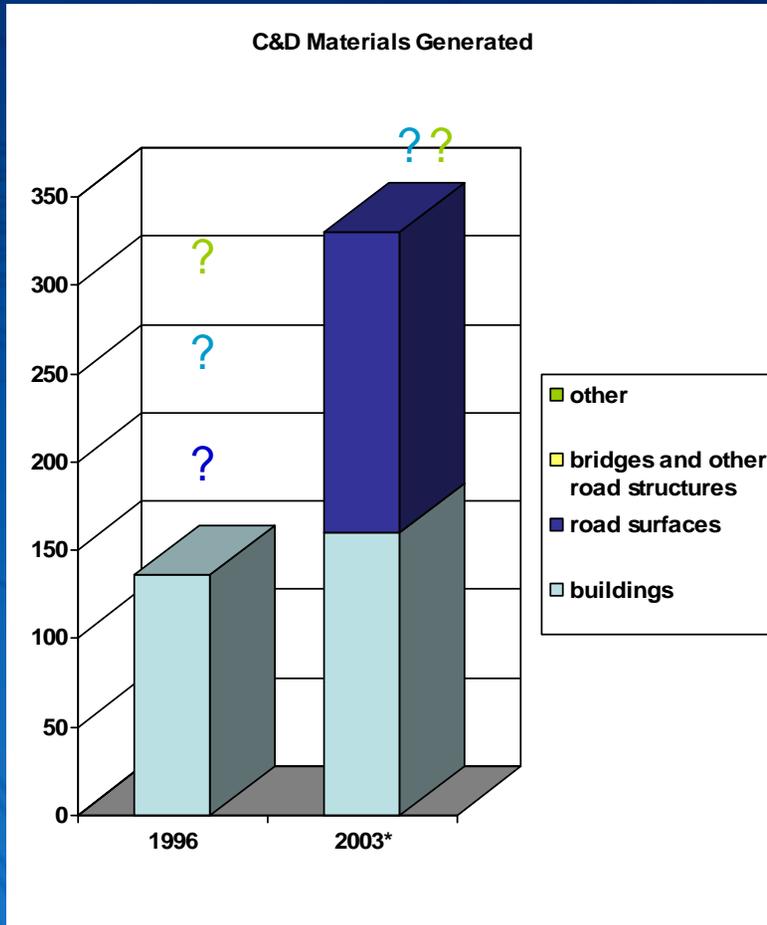
State Programs & Regulations

- Massachusetts ban on disposal before processing
- California requires 50% diversion from landfills
- Various states have grants and education programs

Local Ordinances

- Disposal bans
 - Ban of specific materials from being disposed
- Waste plan requirement
 - Require all contractors to submit plans on how they will reduce disposal when applying for a permit
- Deposit system
 - Fee required when applying for a permit that is returned when recycling is proven
- Salvage period requirements
- Green building requirements
- Green purchasing requirements

Amount Generated/Recycled



*Preliminary results

Measurement: C&D Materials

- For the future – Measure annually
- Currently looking at data states collect and publish
 - Disposed
 - Recycled
 - Generated

Bob Brickner
How C&D materials are reused
and recycled

How C&D Materials are Reused and Recycled

Presentation by: Bob Brickner , Executive V-P
Gershman, Brickner & Bratton, Inc. (GBB)
Fairfax, VA

Presented on RCC Webinar Feb. 21, 2008

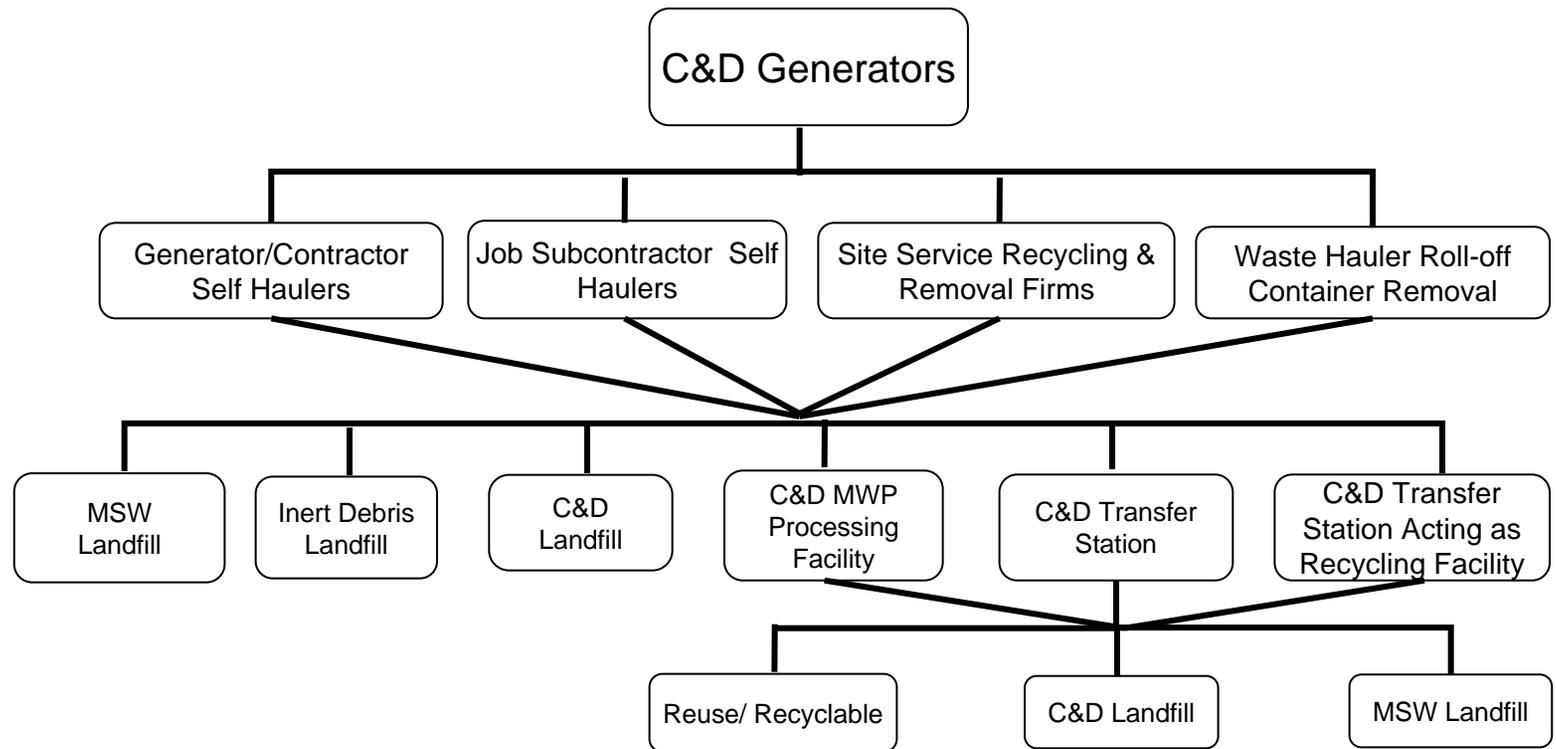
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Classification & Sources of C&D

- Site Clearance Materials
- Excavated Materials
- New Construction Materials
- Renovation, Remodeling or Repair Materials
- Demolition Debris Materials
- Roadway Materials
- Bridge Material
- Disaster Debris

C&D Management System Options



C&D Waste – Main Sources

- Demolition Debris
- Renovation Waste
- New Construction Waste

C&D Generator/Contractors as Self Haulers

Example: Demolition Companies having their own General Contracting firm to transport concrete, structural steel or landclearing debris, for example, to their own Concrete Crushing Plants, Scrap Yards or Wood Processing Facilities for processing into marketable products – also “clean fill” dumps or reuse “into the old basement cavity”

Example: Road Contractors grinding their own on-site concrete pavement into base aggregate for widening of roads, for example

C&D Job Subcontractors as Self Haulers

Example: Land Developers/General Contractors hiring Land Clearing Firms to take down trees and remove for use as:

- Lumber
- Mulch
- Boiler Fuel

Site Service Removal & Recycling Firms

Example: Local Collection Haulers using on-site multi-bins w/site-to-site collection trailers to segregate materials (e.g. OCC, metals, wood) for haul to transfer stations with “recyclables drop-off areas”

C&D Waste Hauler Roll-Off Container Removal

Example: Traditional Mixed C&D 30 CY ORO container collection service with hauling to mixed C&D waste processor; could be pulling 10 CY boxes of asphalt shingles from re-roofing job or 20 CY box full of gypsum wallboard scrap

History

- Many old and played-out gravel pits are now closed old C & D landfills
- Many gravel pit operators are using “rock crushers” to crush concrete and asphalt pavement in their hollowed-out pits

Typical Accepted Materials within Mixed C&D Waste

- Any mixture of inert and woody items (LC)
- Mixed construction & demolition debris
- Asphalt Shingles
- Dimensional Lumber
- Wood Composites
- Drywall
- Suspended Ceiling Tiles
- Tile (ceramic and vinyl)
- Pipe (metal and plastic)
- Reinforced steel
- Wood, Doors incl. furniture
- Metal, Wire, incl. furniture
- White goods (with freon removed)
- Plastics

Sources of Inert Granular Materials in C&D Waste Stream

- Asphalt
- Concrete (C&G Pavement)
- Reinforced Concrete (Roadways)
- Dirt, Soil, and Mud
- Rock
- Rubble
- Block Concrete
- Brick

Potential Product Uses of Inert Granular Materials

- Landfill daily and final covers
- Landfill temporary access roads
- Land reclamation (Inert Fills)
- Base Fill for non-federal roads, commercial parking lots, rip-rap for lake shores



Potential Product Uses of Inert Granular Materials (con't)

- Embankments
- Base and sub-base for roads and airports
- Cover and bedding for landfill liners
- Aggregate for filter layers in: landfills, French drains, bridge abutments
- Asphaltic concrete

2004 Demo of Nashville Thermal 1,000 ton-per-day WTE Facility



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GBB Guided the Project

Six “Major” Dismantlement activities that needed to be completed included:

- Auctions of old equipment using Metro’s eBid Internet site
- Asbestos Removal from Thermal’s heating & chiller plants
- Additional Fencing to secure entire Thermal site
- Removal of Thermal’s UST’s (Underground Storage Tanks) (contained oil used for Thermal’s backup boilers)
- Complete Major Dismantlement & Full-Scale Reuse/Recycling of rest of Thermal structures & equipment
- Placement of Cover Soil & Grass Seeding of site

Concrete Crusher w/Magnet for Aggregate Production



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Convenience Center – Recycled Material Now Paved Over



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Recycled Aggregate and Asphalt as Base Fill on Loop Road at Monofill



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Thermal Demo Summary

Materials Movement & Reuse/Recycle Rate

(Final Job Amounts as of 11/7/2004 Closeout)

<u>Activity / Item</u>	<u>Tons</u>
Auction (Recycled/Reused)	1,093
Demo Steel, Including Rebars & Structural	4,394
Crushed Concrete Aggregate Produced	50,007
Demolition Debris to Landfill	983
Asbestos (Removed/Disposed at Landfill)	21
Scrapped Metal from Auction & UST's	118
Railroad Ties	7
Crushed Asphalt Produced	<u>9,747</u>
Total Weight , all Materials (final job total), tons	66,370
% Recycled/Reused (total 65,366 tons)	98.5%

Overall Dismantlement Project Costs

- **Original Year 2000 Demo Estimate ----- \$2,400,000**
- **Final Project Costs (2004):**
 - **UST-----\$128,000**
 - **Asbestos Removal-----\$86,000**
 - **Fencing-----\$13,000**
 - **Demolition----- \$775,000**
 - **Cover Dirt & Seeding--- \$96,000**
 - **Subtotal Cost----- 1,098,000**

 - **Internet Auction-----(\$983,000)**
- **Actual Net Total Dismantlement Cost --- \$115,000**

Example of Demo Materials Recycled (Reported to GBB by NDA members)

Material	Total Amount Recycled, TPY	% Recycled of total TPY
Concrete	6,845,000	61.2
Wood	350,000	3.1
Brick/Block	510,000	4.5
Metals	940,000	8.4
Sheetrock	45,000	<0.5
Asphalt Pavement	2,675,000	23.9
Other Materials	125,000	1.1
Mixed Stream	100,000	<1
Total	11,590,000	

C&D Materials Accepted as Woody Waste

- Tree parts - Branches
- Woody Land-clearing debris
- Crates
- Pallets
- Dimensional Lumber



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Potential Product Uses of Waste Wood

- Landfill cover
- Fuel
- Animal bedding
- Composting bulking medium
- Boiler fuel
- Feedstock for pulp mills
- Raw material for chipboard
- Wood flour for plastic fiber

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C&D Materials Shipped Recycled

(Issue: Clean segregated vs. Mixed Dirty)

MATERIAL	TONNAGE	% of RECYCLABLES
Inert Out	5,823	19.0%
Shingles Out	5,757	18.8%
Demo Wood Out	3,062	10.0%
Virgin Chip Out	2,922	9.6%
Wood Chip Out	2,518	8.2%
Unscreened Loam Out	2,196	7.2%
Yardwaste Out	1,730	5.7%
Brush Out	1,646	5.4%
Drywall Out	1,604	5.2%
Ferrous Metals Out	1,049	3.4%
Catch Basin Material Out	750	2.5%
Compost Out	661	2.2%
White Goods	393	1.3%
Glass	213	0.7%
OCC Out	168	0.5%
Non Ferrous Metals Out	97	0.3%
Clothes Out	4	0.0%
Total Tons	30,593	100.0%

C&D Processing Site (Salvaging & Shrink Wrapping of Brick)



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Processing & Shipping Costs

(Expensed & deducted from Monthly Revenues)

<u>Material</u>	<u>Activity</u>	<u>Costs</u>	<u>Mrkt. Value or (Charge)</u>
Ground Demo	G,T&D	\$15+43/T	(\$58/ton)
Bulky Demo	T&D	\$63/T	(\$63/ton)
Brush Chips	G,T&D	\$16+0-10/T	(\$6/ton)
		\$16+9-?/T	(\$-/ton)
		\$16+3-14/T	(\$5/ton)
Wood Chips	G,T&D	\$16+9+?/T	(\$?/ton)
Shingles	T&D	\$6+31/T	(\$37/ton)
Sheetrock	T&D	\$30/T	(\$30/ton)
Ferrous Metal	T&Recy.	\$40/T	\$40/ton

Controversy: Are C&D Fines Marketed as ADC – Approved & Counted?

Summary of Actual List of C&D Processing/Recovery Facilities (Full Year)

No.	C&D Accepted (tons)	Quantity of C&D Fines Generated (tons)	% C&D Fines of Total C&D Accepted
1	179,270	17,321	9.7%
2	150,696	124,841	82.8%
3	142,015	121,645	85.7%
4	130,438	123,488	94.7%
5	127,835	85,681	67.0%
6	89,911	12,747	14.2%
7	72,830	46,384	63.7%
8	65,239	26,486	40.6%
9	45,077	26,924	59.7%
Total	1,003,311	585,517	58.4%

Product Values: C&D Recycling

- C&D consists of low valued commodities
- Aggregate/Crushed Stone Pricing:
 - Near Quarries \$3-\$4 / ton
 - Moderate Hauling \$5-\$7 / ton
- Retail Store Competition – Wood/Fixtures
 - Inexpensive: ex. Home Depot & Lowe's
- Materials Revenues/Ton Processed:
 - C&D: \$4-\$9/ton vs. MRF: \$90-\$110/ton
(remember: you don't ship C&D to China!!)

Keys to a C&D Project SUCCESS

- Political Will....The Mayor or County Administrator may need to set the Recycling Agenda
- Knowledgeable and Motivated Project Team
 - Outside experts working with local team helps
- Aggressive Product Markets Development
 - Public Sector needs to become a Market player, not just an observer
- Luck...(but sometimes you make your own!)
- As you saw in Nashville Project: Achieved 98.5% reuse/recycle @ 5% of the original budget...neither were thought possible when the project started

Bob Brickner

How can local governments
encourage recycling: Case Study
of Portland, ME

Evolution of Managing C&D in Portland Maine



Presentation by: Bob Brickner , Executive V-P
Gershman, Brickner & Bratton, Inc. (GBB)

Presented on RCC Webinar Feb. 21, 2008

With GBB's Client Contact: Troy H. Moon
Solid Waste Manager, DPW
Portland, ME

Where's Portland?
(Maine's Largest City
w/Pop. 65,000)



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GBB Hired to Complete:

**Operations Review of
Riverside Recycling Facility
for the
City of Portland, Maine**

Conducted: Fall 2004 & Winter 2005

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History

- Turn of the century – 1990s, Hamlin's Pit, an old gravel pit turned into a (predominantly) C & D landfill
- Closed and capped in 1996
- Riverside Recycling v. 1.0 comes into being

Riverside Recycling

Public / Private Partnership (focus on recycling materials)



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The Concept

- Separate recyclables
- Market materials to generate revenue / reduce cost
- Generate tip fees to offset disposal costs

GBB Scope

- To review the history and evolution of the current Riverside Recycling Facility
- Describe the current services being provided at Riverside
- Review the current economics of the business arrangement w/Contractor
- Discuss options for moving forward once the current contract term expires

Contractors Obligations to City

- Complete day-to-day operation of the Facility
- Operations include:
 - Receiving/monitoring all input material
 - Counts and Volumes of Residential Users
 - Weighing commercial vehicles
 - Directing input materials to stockpiles
 - Processing materials, as/if applicable
 - Developing recyclables markets
 - Selecting most economic disposal options
 - Loading out trucks for haul to markets or disposal sites
 - Receiving tipping fees, punches and/or billing commercial customers
 - Developing monthly financial report to City

Contract Timeline & City Amendments w/Contractor

Contract Effective	Nov. 1, 1996
1 st Amendment	July 9, 1997
2 nd Amendment	May 20, 1998
3 rd Amendment	Jan. 26, 2000
4 th Amendment (1)	Starting July 1, 2000
End of Contract	October, 2005

(1) Annual Cost adjustments negotiated as greater of 3% or 80% of Boston CPI.

Estimate of 2004 Receipts

Material	"Residential" Tons - Est.	"Commercial" Tons	City of Portland Tons	Summary Tons
Brush	1538	258	880	2676
Demo Wood	437	2020	84	2541
Yard Waste	2282	14	706	3002
Brick and Block	64	48	36	148
Drywall	730	8	0	738
Shingles	250	45	0	295
Mixed C&D	2748	20806	1802	25356
Metals	62	120	290	472
Inert	603	547	6931	8081
Non Recyclable	637		87	724
Other (1)	2768	121	38	2937
Total	12119	23926	10858	46970

(1) Includes tonnage related to 21,692 residential punches in 2004.

2004 Receipts Summary

	<u>Count</u>	<u>% Count</u>	<u>Vol. CY</u>	<u>% CY</u>
Residential Input(1)	60,520	85%	92,526	30%
Commercial Input	10,882	15%	212,418	70%
TOTAL	71,402	100%	304,944	100%

(1) Includes Resident Punches

Review of Cash Flow Math (City Perspective)

Total monthly operational revenue receipts

-

All Site Expenses for Handling & Disposal
(Including Contractors Monthly Grinding &
Trucking Costs plus Certain Material
Revenues)

=

Monthly City Payment from Operations

History of Management Fees (Paid to Contractor by City)

Start	End	Monthly \$	Annual Equivalent \$
Nov. 1, 1996	June 30, 1997	33,516	402,192
July 1, 1997	June 30, 1998	42,145	505,745
July 1998	June 1999	65,061	780,737(1)
July 1999	Dec. 1999	64,542	774,500(1)
Jan. 2000	June 2000	70,112	841,344(1)
July 2000	June 2001	74,112	889,344(1)
July 2001	June 2002	68,574	822,888
July 2002	June 2003	70,631	847,575(2)
July 2003	June 2004	72,750	873,000(2)
July 2004	June 2005	75,250	903,000(2)

- (1) Included \$8,112 per month for Note of \$345,000 paid by City from March 1999 until August 2001.
- (2) Annual Cost adjustments negotiated as greater of 3% or 80% of Boston CPI.

Riverside Recycling Facility

(Summary of Contractors Annual Reports)

Year	Site Revenues (Tip Fees & Market Sales)	Total Expenses (1)	Net (Returned to City)
FY 01	\$ 2,484,345	\$ 2,050,515	\$ 433,830
FY 02	\$ 2,397,495	\$ 2,118,854	\$ 278,741
FY 03	\$ 2,578,998	\$ 2,208,238	\$ 370,760
FY 04	\$ 2,912,912	\$ 2,515,559	\$ 397,353

(1) Exclusive of City costs paid as Annual Management Fee.

Summary of City Cash Flows

(Annual mgt. fee-City share rev.= Net City Cost)

Year	Mgt. Fees	Net Payments Returned to City	Annual Net Cost to City
FY 01	\$ 822,888	\$ 433,830	\$ 389,058
FY 02	\$ 847,575	\$ 278,741	\$ 568,834
FY 03	\$ 873,000	\$ 370,760	\$ 502,240
FY 04	\$ 903,000	\$ 397,353	\$ 505,647

2004 Residential Origin & Volumes (Code 110)

<u>Origin</u>	<u>Vehicle Count(%)</u>	<u>Volume (%)</u>
Portland	68%	75%
Maine, Gen'l	4%	4%
So. Portland	2%	2%
Scarborough	2%	2%
Westbrook	7%	5%
Falmouth	3%	2%
Yarmouth	1%	1%
Windham	5%	3%
All Others (16)	8%	7%
Total	100%	100%

Value of Lower Annual Shipments (i.e. the waste is stored at the site)

- Example: Product Shipments in 2004 vs. 2003 were lower by 6,624 tons
- If the average cost to Grind, T & D is \$55/T
- The “retained” cash flow is \$364,309 and available “to share” with the City
- For reference, the CY 2004 funds returned to City by Contractor from revenues received was \$397,353
- But, the material still must leave the site eventually at the going rate of disposal!

Stored C&D Materials on Site at Riverside (Estimated during field visit of Nov. 22, 2004)

Type of Material	Est. Weight Tons
Inerts, Rock, Brick, Stone (7 piles)	16,078
Street Sweepings, Mountain	8,867
Residential C&D Drop-off	4,806
CBI Ground Demo (2 piles)	4,483
Shingles	2,491
Leaves/Compost (5 piles)	1,224
OBW Pulled Out (2 piles)	642
Wood, Processed & not (2 piles)	524
Brush, Processed & not (2 piles)	465
Metal, incl. Nails Box (2 piles)	146
Other (Glass, Sheetrock, Tires, etc.)	1,268
Total	40,994

Issues for Consideration w/Current Contractor

- Liability for C&D materials left onsite at end of existing contract
(GBB estimated in Dec. that over 40,000 tons of materials piled on the site...potential for \$1.5- 2 million disposal costs)
- Security if Contractor defaulted on contract as new disposal costs erode cash flow (Initial Performance Bond under contract was eliminated by the City)
- Liability: Site also had pile fires (in 2001 & again in late Sept. '04)

Issues for Consideration w/previous Contractor

- Contract had minimal/no incentives for the Contractor to reduce the “net costs” monthly costs of the Riverside project to the City.
- Contractor’s monthly reporting history presented minimal information to the City about the detailed operations and financial parameters of the Project
- Key to Recycling Project success is obtaining economical materials markets at reasonable handling/processing costs. The former “deal” did not ensure that effort.

Issues for Consideration w/Current Contractor

- City delivers substantial quantity of Inert materials to the Recycling Facility but, for unknown reasons, is not being aggressive in providing Marketplace opportunities to use of this material on City Projects.
- Based on the basis of the tipping fees being charged, the City does receive “free disposal services upfront”, but the Net Project Costs per month to City becomes a “de facto tipping fee” charge

Summary of Initial Issues

- Little to no data regarding tonnages – overwhelmed immediately
- No scales – all transactions initially by estimated volumes; lot of “freebie” tonnages
- Operator received a set management fee per month, no incentives to perform well
- Contract artificially limited operator’s cash flow & hindered his ability to move materials
- Lack of direct City involvement with site management operation

Problems continued...



- Material not moving
- Poor record keeping
- Fires
- Unpleasant customer experience

Options for City Consideration

- Renegotiate extension of the current contract with more favorable terms before it expired on October 31, 2005
- Issue a Request For Proposal for recycling/disposal services to handle either:
 - (1) City-only C&D generated by residents & City vehicles; or
 - (2) All the same regional waste streams as accepted at the current facility (if new deal can be competitive)
 - (3) Split the service requirements (have C&D provider and another yard waste/composting site service provider.

GBB Recommendation that City Accepted

1. The long-term City liabilities associated with the near-term life of the contract needed to be carefully monitored by the City to minimize cost exposure.
2. The City needed to immediately assess what services it wants to consider purchasing within the context of a new and detailed RFP.

View of the problem(s)



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Contracted with GBB to...

Developed RFP to find:

- Expertise in material handling
- Equipment or available capital to get equipment
- Demonstrated commitment to recycling
- Ability to help us clean up & redevelop the site.

Riverside Recycling 2.0 is born – New and Improved!!

GBB

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Riverside Recycling



- Public / Private Partnership
- CPRC Management handle materials
- City staff handle customer service, money and scales
- Focus on recycling materials

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CPRC Group

The leader in conversion technology.

- Formerly Commercial Paving and Recycling
- Emphasis on soils, aggregate, asphalt and inert materials
- Variety of beneficial use permits
- Manufacture recycled construction products and reclaimed soils
- Strong management team with experience in major waste handling companies

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New contract

- City pays CPRC a set fee per ton when material leaves the facility (with exceptions).
- CPRC has financial incentive to recycle
- City controls the scale, the money and the customer service experience
- City keeps all tip fee revenue
- CPRC accepts ownership of the material as soon as it hits the ground.

How the incentive works:

- Fee per ton = landfill T&D cost
- CPRC makes \$ by finding lower cost alternatives to landfill
- Lower cost = higher margin



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Source Separate or Pay



\$85.00 / ton for mixed material, discounts for sorted material

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Using E-Cards



Resident presents card

Attendant scans card
and enters data about
load

Computer deducts from
account, charges fee if
required

E-card users must
recycle

We track usage of
cards

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New HHW and Universal Waste Facility Developed



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2007 Outbound Material

- Recycled 30,593 tons (46.5%)
- Landfilled 34,850 tons (53%)
- Total 65,837 tons

- Note: Other (On-site) 394 tons (0.5%)

Outbound Material Recycled

MATERIAL	TONNAGE	% of RECYCLABLES
Inert Out	5,823	19.0%
Shingles Out	5,757	18.8%
Demo Wood Out	3,062	10.0%
Virgin Chip Out	2,922	9.6%
Wood Chip Out	2,518	8.2%
Unscreened Loam Out	2,196	7.2%
Yardwaste Out	1,730	5.7%
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Compost Out	661	2.2%
White Goods	393	1.3%
Glass	213	0.7%
OCC Out	168	0.5%
Non Ferrous Metals Out	97	0.3%
Clothes Out	4	0.0%
Total Tons	30,593	100.0%

Some Numbers...

**City of Portland
Riverside Recycling Facility
Comparison of Tonnage in to Tonnage Out
FY08**

	Tonnage in per City				Tonnage out Per CPRC	Difference	Paid %
	Paid Tonnage	Unpaid Tonnage	E-Card Tonnage	Total Tonnage			
July	3,320	1,788	1,579	6,687	9,045	2,357	49.65%
Aug	3,180	2,857	1,644	7,681	7,598	(82)	41.40%
Sep	2,664	1,423	1,470	5,557	5,359	(198)	47.94%
Oct	3,232	1,287	1,758	6,277	8,907	2,630	51.48%
Nov	3,563	1,277	2,506	7,346	5,858	(1,488)	48.50%
Dec	1,898	112	652	2,662	3,174	512	71.30%
January	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-
	17,857	8,744	9,609	36,210	39,941	3,731	49.31%



Reduced Cost to City

- CPRC costs approximately \$3,000,000/ Year
- Revenue from commercial customers approximately \$2,650,000
- Cost to City is approximately \$350,000 / year



- City operations approximately 16,000 tons
- Resident “freebies” approximately 16,000 tons
- 32,000 tons x \$40 = \$1,280,000

Almost \$1,000,000 saved / year

GBB

Gershman, Brickner & Bratton, Inc.

Why City did it themselves?

- Much easier to manage the “freebies” they offer their residents
- Philosophy of controlling own programs & resources
- Desire to have direct involvement with site management
- City Finance Dept. wanted City staff handling all funds



Thank You....any questions

Bob Brickner 703-573-5800

Bbrickner@gbbinc.com

GBB

Gershman, Brickner & Bratton, Inc.

Jenna Jambeck
C&D Recycling in New England

C&D Debris Recycling in New England

A Resource Conservation Challenge Web
Academy Presentation



Jenna Jambeck, PhD

Recycled Materials Resource Center

Civil/Environmental Engineering

University of New Hampshire

Recent NE C&D Issues Summit

- ⌘ Environmental Business Council of New England's Second Annual Regional Construction and Demolition Debris Summit
- ⌘ January 25, 2008
- ⌘ Organized/Sponsored by public (MA DEP), private (consulting, etc.) and industry organizations (SWANA, NSWMA, NEWMOA)

Recent NE C&D Issues Summit

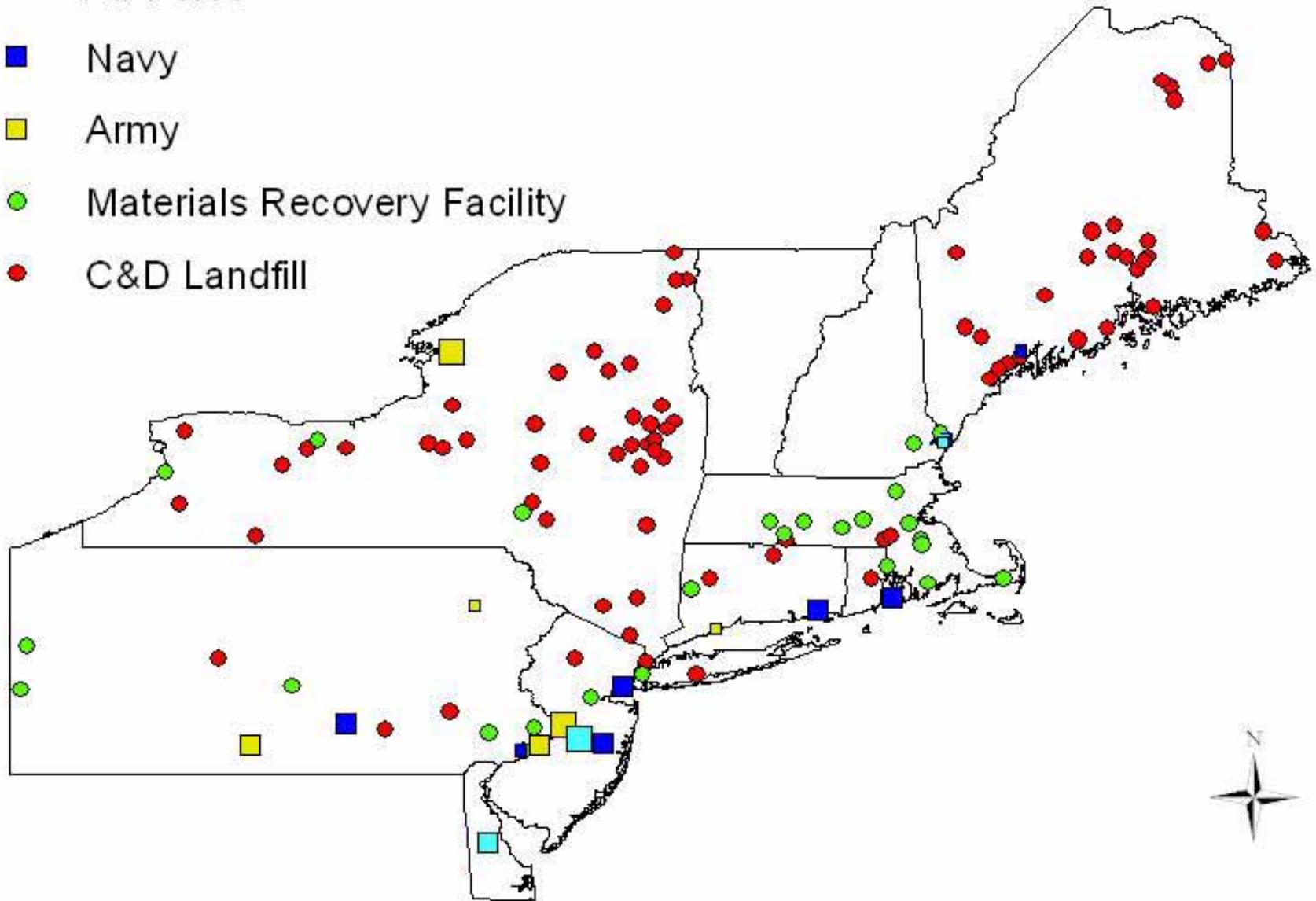
- p Addressed C & D issues from throughout the northeast
 - n New regulatory structures
 - n Current management options
 - n New or emerging management trends
 - n A dialogue among construction contractors, architects, waste haulers, C&D processors and regulatory officials

Stand-out Topics

- p Each state regulatory agency summary
- p C&D Wood Waste
 - n ME takes most wood, new gasification facility in MA
- p C&D Processing Residuals and Fines
 - n ADC - UNH Research
- p Gypsum Wallboard
 - n Recycling in MA and NH
- p Asphalt shingles
 - n Recycling in several of the states
- p Rail haul
 - n Permit and transport issues
- p Disposal ban expansion (MA)
 - n Wallboard and shingles - eventually?

Legend

- Air Force
- Navy
- Army
- Materials Recovery Facility
- C&D Landfill



Rhode Island (2000): Disposal and Recycling

- p C&D debris
 - n 90,460 tons (NEWMOA 2002)
 - n Falls under MSW regulations
- p No longer has C&D landfills (3 MSW landfills that take C&D debris)
- p Regulations for C&D processing facilities (2001)
 - n Financial assurance
 - n Operating plan required (screening of waste)
 - n Buffer zone required
- p <http://www.dem.ri.gov/programs/benviron/waste/index.htm>

Connecticut (1991): Disposal and Recycling

- p Construction and demolition debris
 - n 893,800 tons (NEWMOA 2002)
 - n Dry waste (does not include C&D debris)
- p No liner specifications, but regulatory flexibility allows for requiring liners for expansions and new landfills
- p Financial assurance required
- p Operator training required
- p Groundwater monitoring required
- p State solid waste plan recommends exploring recycling options
 - n Recycling resources available on website
 - n Aggregate recycling facilities listed
- p http://www.ct.gov/dep/cwp/view.asp?a=2718&q=325402&depNav_GLID=1646

Vermont (1999): Disposal and Recycling

- p C&D debris
 - n 79,080 tons (NEWMOA 2002)
- p Liner requirement conditional
- p Groundwater monitoring required
- p Financial assurance
- p Recycling may be required
 - n Metal, cardboard
 - n Construction waste reduction plans
- p Heavy into *Deconstruction*
 - n Numerous case studies (5 on website)
 - n Example reduction plans on website
 - p CHITTENDEN SOLID WASTE DISTRICT
 - p % Change C&D FY 94-05 = 168.4% (26,770 Tons)
 - p % Change MSW FY 94-05 = 29.9% (23,755 Tons)
- p <http://www.anr.state.vt.us/dec/wastediv/recycling/CandD.htm>

Maine (1999): Disposal and Recycling

- p Construction, demolition and C&D debris
 - n 33,900 tons (NEWMOA 2002)
 - n Inert fill, land-clearing debris (does not include C&D debris), but may go into C&D debris landfill
- p No liner required, depending on soils, may require leachate extraction
- p Voluntary operator training, spotters required
- p Require a waste management plan that minimizes landfilling and maximizes recycling
- p Regulations for processing facilities
 - n Produce product or residual meeting specs
 - n Proper storage/processing area, control leachate, environmental monitoring program may be required
- p <http://www.maine.gov/dep/rwm/>

New Hampshire (1997): Disposal

- p C&D debris
 - n Dry waste
- p Liner required with leachate collection
- p Financial assurance required
- p Operator training and spotter required

New Hampshire (2007): Recycling

- p 702,000 tons of C&D debris generated in 2006
 - n 304,657 tons (43%) recycled/diverted from landfill
- p Regulations for C&D processing facilities (2 facilities)
 - n Processing facilities recycling rate 83%
- p Construction wallboard recycler (GP) in Newington, NH
 - n >8,700 tons annually
 - n Market growing
- p Permanent ban on combustion of C&D wood (NH HB 427 and 428)
- p State C&D Task Force - recent draft report
- p http://www.des.state.nh.us/waste_intro.htm

Massachusetts (2005): Disposal

- p C&D debris
 - n 905,000 tons (NEWMOA 2002)
- p Double composite liner required
 - n May be less if slope of landfill, permeability, leachate quality or other characteristics of the waste are considered
- p Financial assurance required
- p No operator training or spotter required
- p Groundwater monitoring is required
- p Leachate collection required

Massachusetts (2007): Recycling

- ⌘ Permit required for mixed C&D debris processors
- ⌘ Banned concrete, asphalt, brick, wood and metal from landfill disposal in July 2006 (must be processed) - expanding?
- ⌘ Construction wallboard processor in Cambridge, MA (expanding)
- ⌘ Many mixed C&D processing facilities (~8)
- ⌘ <http://www.mass.gov/dep/recycle/reduce/managing.htm>

States

- p Data/Survey from 2003
- p Published in March 2006
- p Many changes since 2003...
- p Contact me for copy of paper

February 21, 2008
RCC Web Academy

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A Review of Construction and Demolition Debris Regulations in the United States

CORRIE CLARK

*Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor,
Michigan, USA*

JENNA JAMBECK

*Department of Civil/Environmental Engineering, University of New Hampshire, Durham,
New Hampshire, USA*

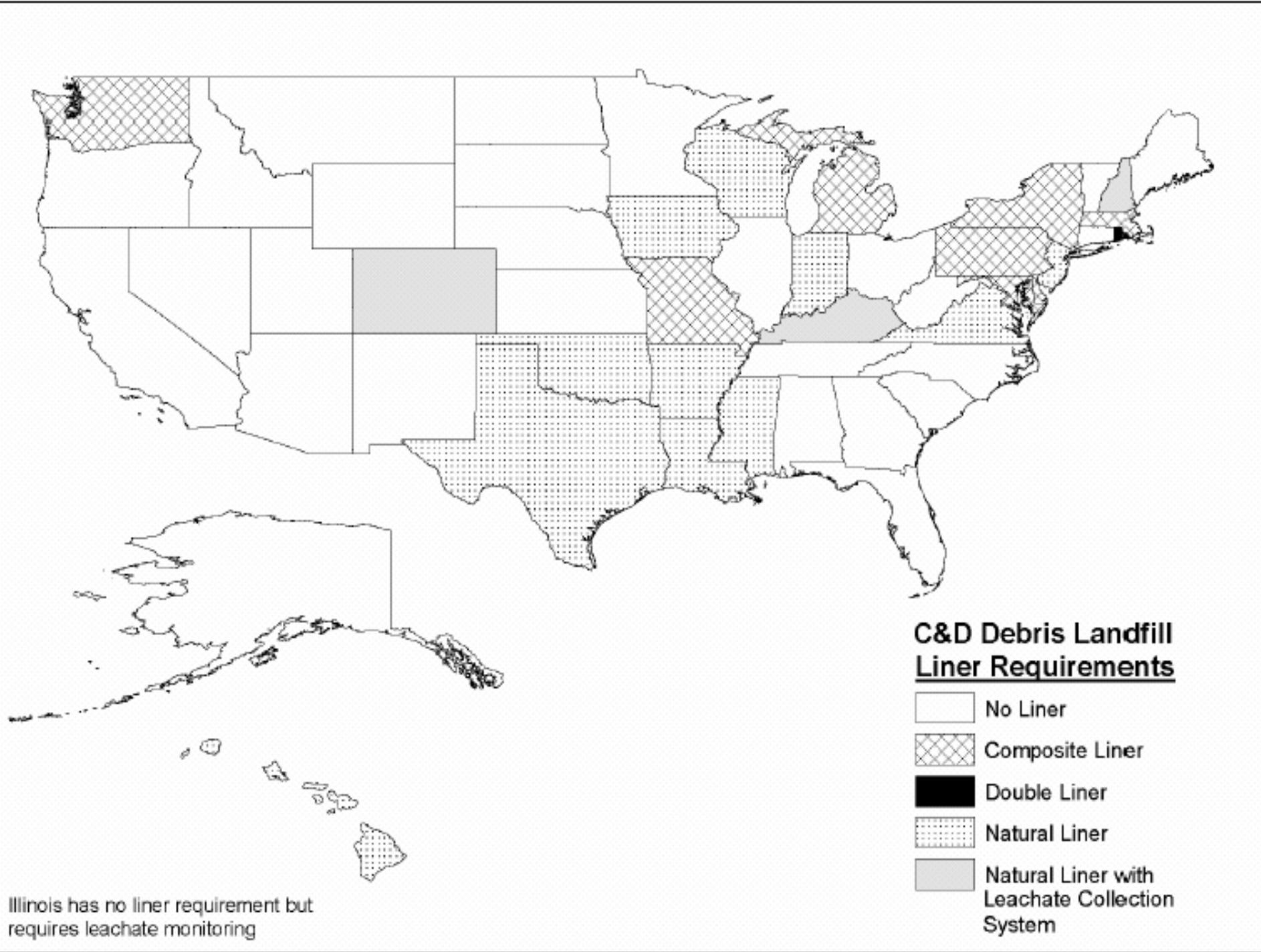
TIMOTHY TOWNSEND

*Department of Environmental Engineering Sciences, University of Florida, Gainesville,
Florida, USA*

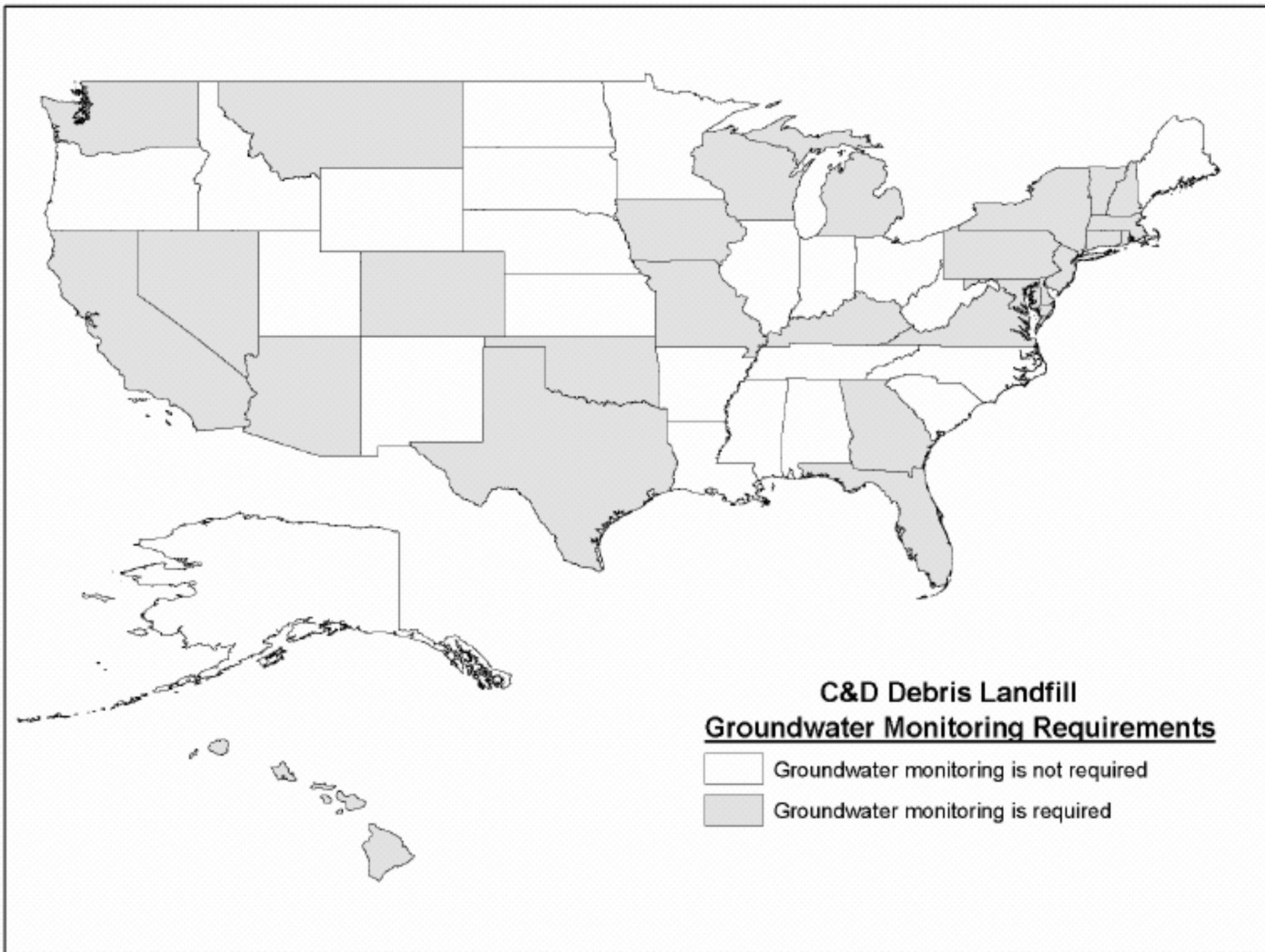
Construction and demolition (C&D) debris comprises a significant portion of the solid waste stream in the United States. Because C&D debris is largely regulated at the state level, the requirements for C&D debris disposal facilities vary from state to state. A review of state regulations was conducted to determine C&D debris disposal facility requirements, including specific requirements for liners, leachate collection, groundwater monitoring, location restrictions, operator training, waste spotters, final cover, financial assurance, and recycling. This review found that little consistency exists in the regulation of C&D debris facilities among states. Twenty-three states require liners, while 27 require groundwater monitoring. Seventeen states reported having regulations pertaining to recycling C&D debris. Several states are currently in the process of reviewing and updating their C&D debris regulations, an indication of the greater recognized importance of this fraction of the solid waste stream.

The authors acknowledge Joe Aufmuth, Faculty Librarian and GIS Coordinator, and Jones Edmunds and Associates for their assistance in the development of the included maps. The authors thank the solid waste regulatory programs in each state for their participation in the survey and their comments on draft versions of this article.

Address correspondence to Timothy Townsend, Associate Professor, Department of Environmental Engineering Sciences, PO Box 116450, University of Florida, Gainesville, FL 32611, USA. E-mail: ttown@ufl.edu



Illinois has no liner requirement but requires leachate monitoring

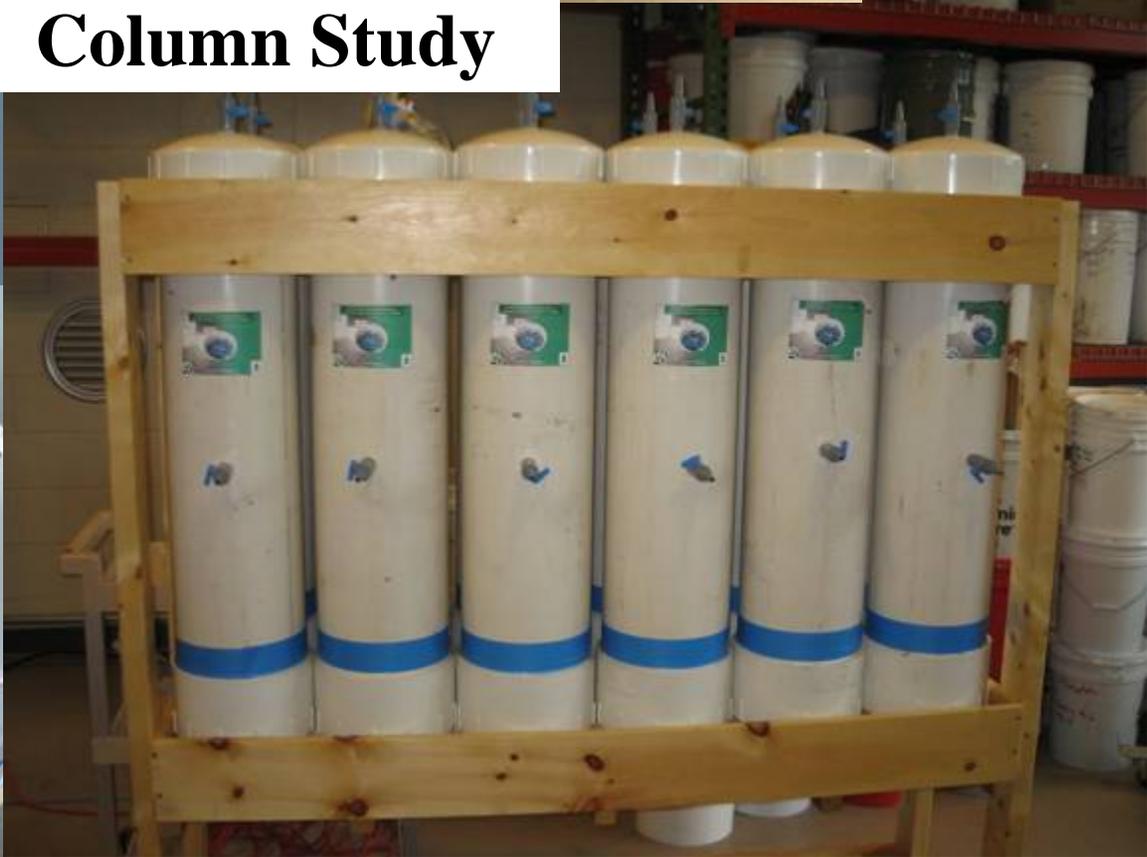


Use of C&D Debris Fines and Recycled/Industrial Materials for Attenuation of H₂S

- p Several projects on-going...
- p Large resource/high availability
- p Lower cost
- p Attenuation characteristics
 - n Sorption or chemical reactions
 - n High percentage of carbon, lime or iron
 - n Able to be mixed-in/used in layers
 - n Investigations in Florida and New England indicated that various recycled/industrial materials can attenuate hydrogen sulfide
- p If attenuation successful, would then consider environmental component
 - n context of use, and e.g., total/leachable metal content



Column Study



Summary – Preliminary Data

- p Attenuation materials perform differently ex-situ and in-situ
- p Of materials tested so far, wood ash best for ex-situ attenuation
 - n Further testing of this and other materials in process
- p From materials tested, soil appears to be best for in-situ attenuation of concentration and volume of hydrogen sulfide
 - n Dilution 2:1 or 3:1 (soil : fines)
- p Wood ash - no in-situ attenuation
- p If recycling is required, there must be markets for the products. If recycled/industrial materials available, may be able to use them at less percentages than soil, maximizing use of C&D fines
- p Contact me for reports/papers

RMRC Overview



MISSION

Overcome barriers to the appropriate use of recycled materials in the highway environment

- p Established in TEA-21 in 1998, reissued 2007
 - n University of New Hampshire and University of Wisconsin - Madison
- p National center in partnership with FHWA & EPA
- p Focus on the long term engineering and environmental performance of recycled materials in the highway environment
- p Primary activities are research and outreach

Approach

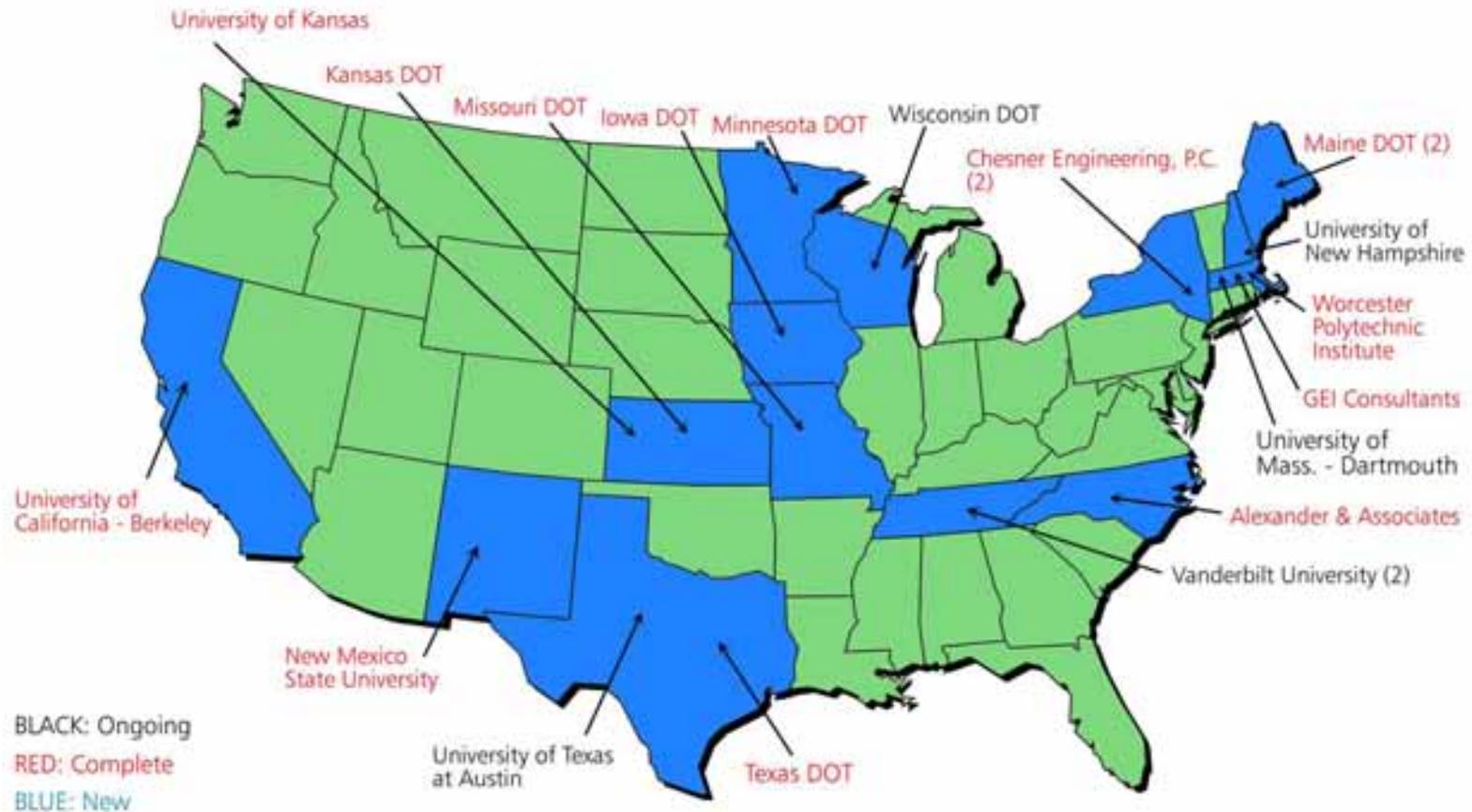
p Numerous Materials

n Coal fly ash/bottom ash, shingles, foundry sand, asphalt, concrete, glass, tires, mine waste, etc.

p Recycled materials focus areas:

1. Testing and evaluation guidelines and specifications
2. Material-application specific research and development
3. Environmental, economic, and institutional issues
4. New materials and innovative technologies
5. Field trials of secondary materials
6. Technical services
7. Technology transfer and training

Research Map



www.recycledmaterials.org

February 21, 2008
RCC Web Academy

Jenna Jambeck, PhD
University of New Hampshire

Thank You – Questions?

p Contact information:

Jenna Jambeck

Recycled Materials Resource Center

www.recycledmaterials.org

University of New Hampshire

Jenna.Jambeck@unh.edu

Phone: 603-862-4023

