



# Sustainable Use of Quarry Resources

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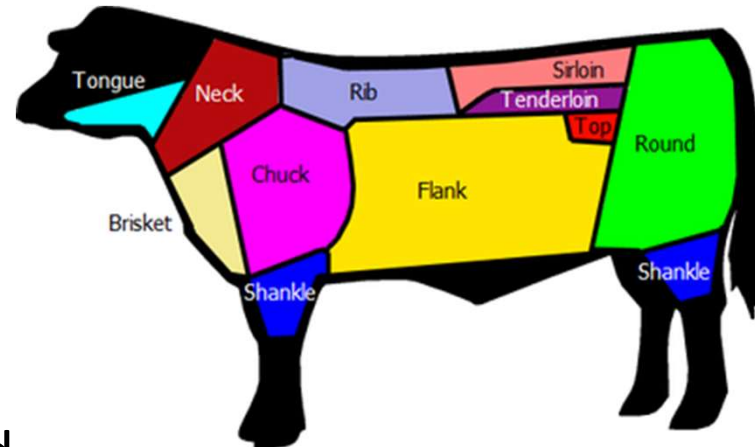


# Construction Aggregates

- The most basic building block for construction of all types
- Every American uses about 10 tons of aggregate per year
- Directly or indirectly, aggregate is the most used product on VDOT projects.
- Not like a manufacturing industry however
  - We can't selectively make one type or size of aggregate
  - When we make coarse aggregate, we also make fines and base at the same time

# Construction Aggregates

- Our product is like the beef industry
- Multiple cuts of beef are made
- Can't make only tenderloin
- Someone has to buy the other cuts
- Otherwise, the tenderloin would be un-affordable



# Construction Aggregates

- Construction aggregates are the same way
- When we crush stone, we make approximately the following:
  - 30-45% coarse aggregate
  - 20-35% fine aggregate
  - 30-40% aggregate base



# Construction Aggregates

- We do everything we can to optimize our plants and to match production to sales
  - Plant Studies
  - Crusher Studies
  - Process Improvement Reviews
  - There are limitations

# Plant Design & Cost

- Plants are designed for the product demand at that point in time
- North Quarry (North Carolina): 1999 for \$9.4 million
  - Demand at that time was well balanced with fines and ABC
- East Forsyth Quarry (North Carolina): 2016 at a cost of \$14.7 million
  - Demand was screenings when built, but not now
- Graham Quarry (Virginia): 2022 for \$40+ million
  - Heavy clean stone market

## Upgrade Costs

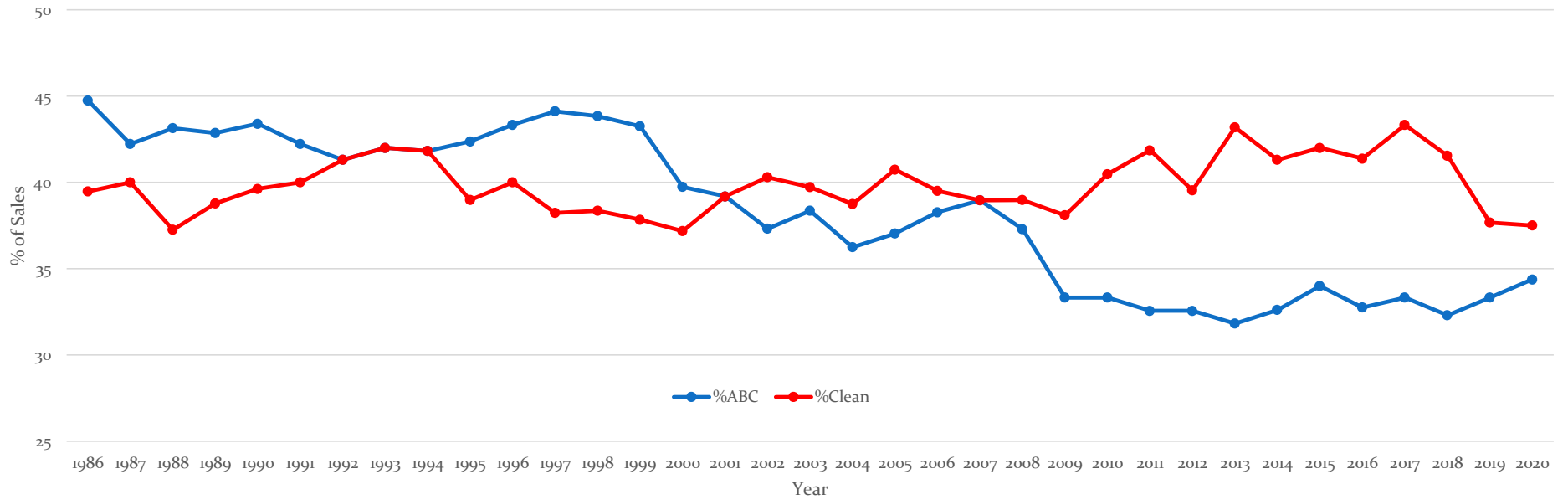
- A new crusher could cost up to \$700,000 depending on setup
- A new screen could cost up to \$300,000 depending on the size
- Simply changing a crusher liner costs around \$45,000

# Product Demand

- When markets change and product demand changes, it's difficult to modify what we do
  - We can modify our product proportions some, but can't stop making certain products
- Sales over the last decade or so have leaned heavily towards coarse aggregate and less on fines and base



# Sales Data From North Carolina



# Factors Impacting Fines and Base Sales

- Coarser asphalt mixes
  - More use of Superpave, SMA, ultrathin, OGFC
- Less new pavement construction in recent years
  - Not as much aggregate base being used
- When there is new construction
  - Designers want permeable base with less fines, or
  - Base is sometimes engineered out

# Factors Impacting Fines and Base Sales

- Lack of acceptance of manufactured sand in concrete
- Increased use of RAP in asphalt
  - RAP is very fine and reduces the amount of virgin fines needed
- Increased use of in place recycling
  - Uses no aggregate base
  - May only use virgin aggregate in the top lift (often coarse mixes like SMA)
  - In place recycling given unwarranted advantages over virgin aggregates
- The result is this...







## Base & Fines in Virginia

- In 2015, Virginia agg suppliers had the following:
  - 6,184,000 tons of aggregate base
  - 910,000 tons of manufactured sand
  - 5,942,000 tons of screenings
- These quantities grow every year as coarse aggregate sales accelerate
  - Bad for the environment
  - Bad for future aggregate costs

## What Can Be Done?

- Several initiatives that could help lead to a more sustainable use of fines and base
- The industry needs help from our partners to implement these





# Manufactured Sand in Concrete

- Many State DOTs have allowed manufactured sand for decades
- National and international research shows it works
- Many concrete producers already use it in commercial work



# Fine Graded Asphalt Mixes

- Fine asphalt mixes, such as 4.75 mm asphalt
  - Great for preventive maintenance

# Use of Fine Aggregate Bases

- 21B contains very little fines
- 21A is quality base product with a good track record
- Drainable bases with lower fines will exacerbate the fines problem
- Industry research has shown that CTA with high fines content is actually more durable
  - Use of screenings as cement treated base



## Stone Matrix Asphalt

- Flat and elongated requirement for SMA cause aggregate producers to generate *even more* fines than normal

## Alternative Uses for Base and Fines

- There is interest in alternative uses of crushed concrete and RAP due to excess inventories of these products
  - These uses generally replace base and fines
  - The aggregate producers in Virginia have excess products far exceeding those of the RAP and crushed concrete
- Nationwide, there is a lack of research into how to help with excess inventories of fines and base
- VDOT has developed some uses for dry screenings in recent years that have helped.

# Alternative Uses of Base and Fines

- Potential ideas for research:
  - Low cost asphalt stabilized base using crusher run/base aggregates
  - Low cost stabilized surfacing for unpaved roads
    - For example, fines or fine base lightly treated with cement
  - Stabilization of poor subgrades by mixing in high quality base or fines
  - Inverted Pavement for new construction



# Construction Aggregates

- The aggregate industry cannot continue building excess inventories of base and fines
- We believe there are many ways that the industry and VDOT can tackle this problem
- We need VDOT's help and cooperation.