

Athabasca Tar Sands

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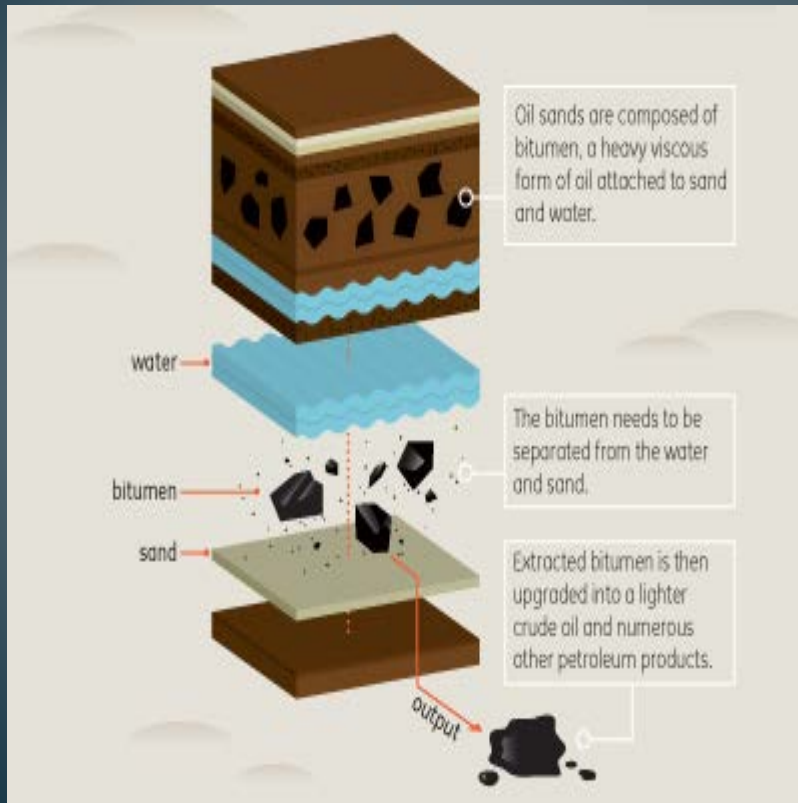
What are the Tar Sands?



- 54,000 square miles
- Equal to the size of Florida
- World's largest energy project, largest construction project, largest capital project

<http://www.mining-technology.com/projects/athabascasands/>

How Do the Tar Sands Work?



- Bitumen is a low-quality, high-cost substitute for oil
- After bitumen is extracted from the earth it is refined to remove impurities and correct the carbon-hydrogen imbalance

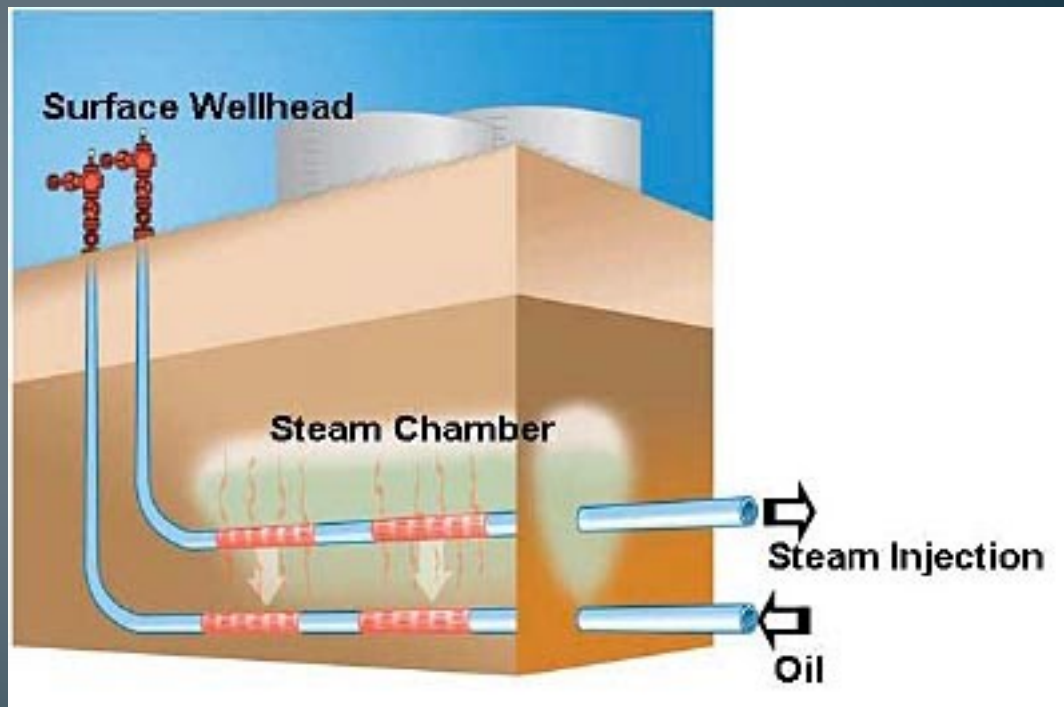
Tar Sands Mining



<http://www.circleofblue.org/waternews/2010/world/epa-and-state-department-square-off-on-tar-sands-pipeline/>

- Sands are mined by massive mechanical shovels
- 100 tons of sand at a time
- Broken into small fragments
- Creation of a slurry
- Screening
- Water waste to tailings ponds

SAGD – Steam Assisted Gravity Drainage

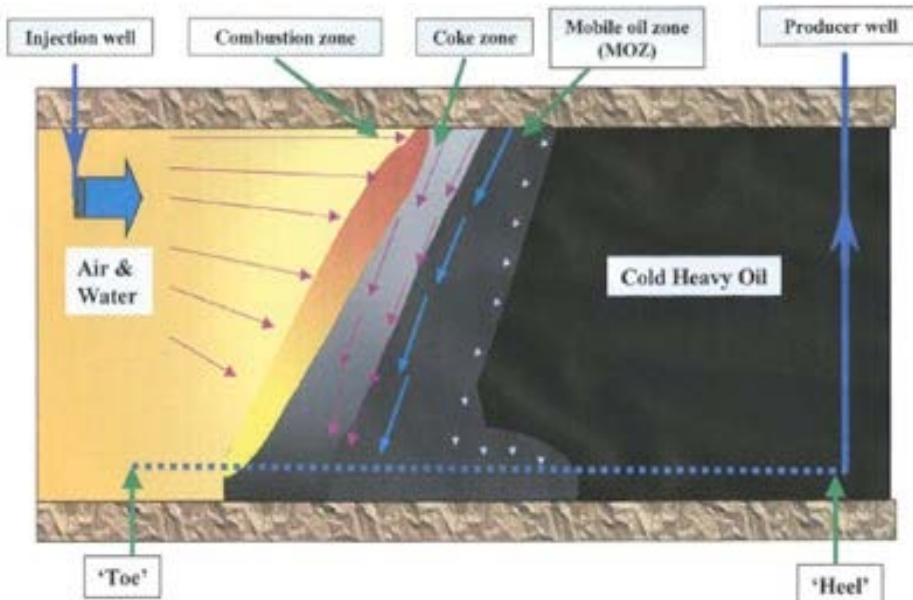


http://articles.businessinsider.com/2011-10-17/markets/30288770_1_oil-sands-mining-pit-liquid-fuels

- Burns enough natural gas to heat 6 million homes each day
- Cost accounts for 60% of SAGD operating costs
- Touted to be wave of the future – Water Operator Courses train students as SAGD operators

Toe-to-Heel Air Injection

THAI Bitumen-Recovery Process



Source: 2005 International Thermal Operations Symposium

A more advanced technology to recover bitumen in situ, Toe to Heel Air Injection (THAI), is advancing toward commercialization.

- Tar is burned in place
- Heat is used to drive off volatile oil
- Requires addition of air to fuel fire

After Mining...



<http://www.newswire.ca/en/story/596389/shell-successfully-completes-athabasca-oil-sands-project-maintenance>

- Shell's Athabasca Oil Sands Project
- Upgrader is the size of 33,702 NHL sized rinks
- After mining, ore is dumped into a crusher, put on conveyor belt 1 600 yards long
- Mixed with light oil, sent to refinery in Edmonton
- 995 miles of pipe

Where Does the Waste Go?



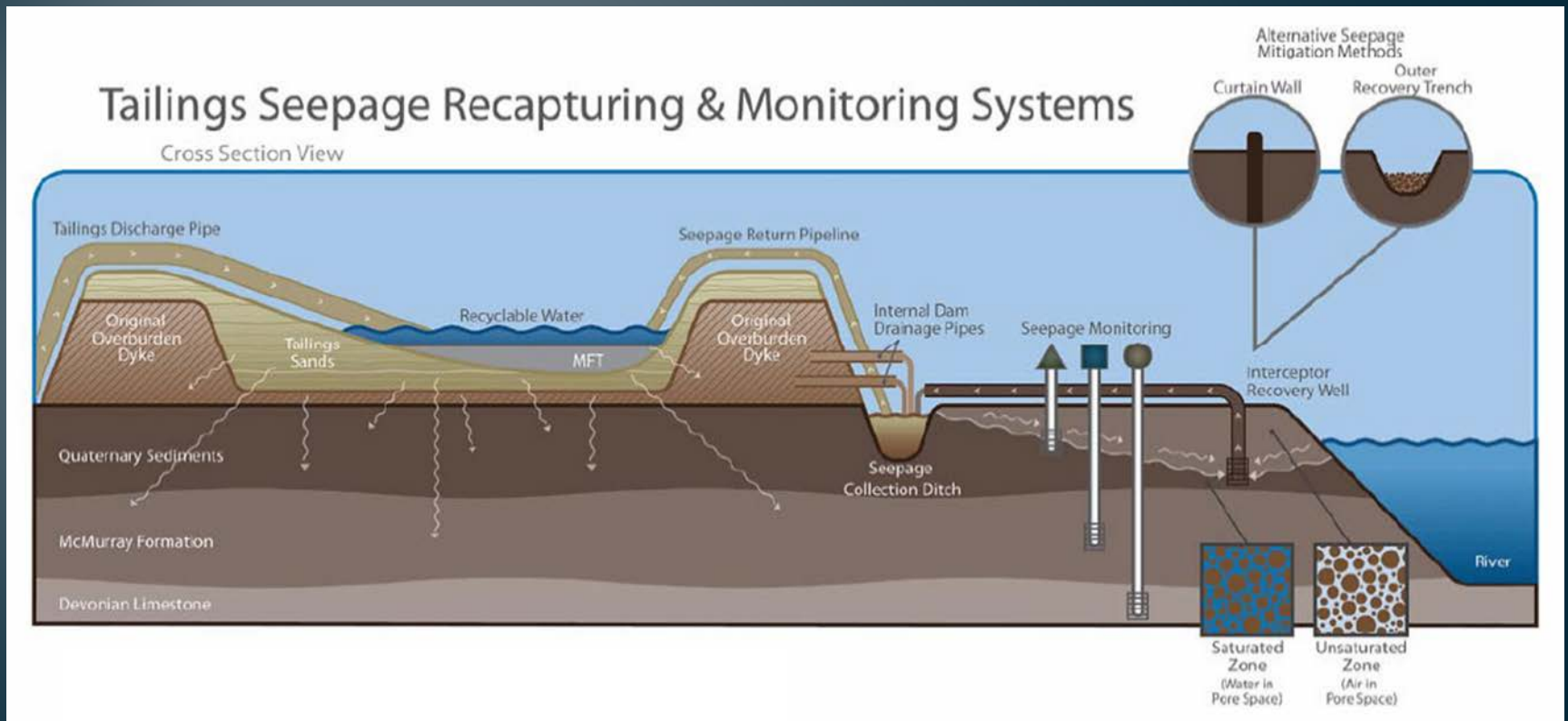
<http://www.maximebernier.com/en/2012/07/une-replique-a-thomas-mulcair-sur-les-sables-bitumineux/>

- Waste water from all methods is sent to tailings ponds
- Contents includes water, fine silts, salts, organic compounds, solvents, naphthalene, arsenic
- They leak or seep into groundwater
- Water is recycled, causing accumulation of these materials

Health Concerns?

- Outbreak in rare cancers in downstream community of Fort Chipewyan – traced back to tailings ponds located adjacent to Athabasca River
- Significant increase in polycyclic aromatic hydrocarbons (one of the top 10 hazardous substances to human health) in lake bottoms – up to 90 km away
- Currently up to 23X normal levels – will only increase as operations continue

Tailings Ponds Monitoring



- Since 2009 tailings ponds now contain groundwater monitoring systems
- Containment dyes to recapture and recycle seepage
- Not failsafe

Other Treatments?

- Some companies have come up with ways to reduce waste to tailings ponds
- Shell – adds thickeners to tailings to allow earlier removal of water
- Canadian Natural Resources Limited – capture CO₂ emissions from operations to mix with tailings. Causes a reaction that forms a solid, allowing for more rapid settling

Conclusion

- Each barrel of bitumen produced consumes 3 barrels of fresh water from the Athabasca River
- 90% of that water ends up in tailings ponds
- Current natural gas use may deplete supply
- Developing nuclear power systems in order to mine
- Each day, open-pit mines move enough earth to fill Skydome

Thank You!

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