The Phosphate Fertilizer Industry: An Overview

Fluoride Action Network

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The purpose of this page is to provide the reader with an overview of the various environmental impacts of the phosphate fertilizer industry. FAN's interest in the phosphate fertilizer industry stems from the fact that the chemicals (fluosilicic acid & sodium fluorosilicate) used to fluoridate water are derived from this industry's air pollution control equipment.

A review of the literature on the phosphate industry finds that along with a fluoride pollution problem, there are other concerns, including, but not limited to: radioactive contamination of the workplace and waste products; spills and leaks of highly acidic, fluoride contaminated waste water which have resulted in massive fish kills; and interference with local ecosystems via extensive strip mining of the land.

The process of making phosphate fertilizer involves a sequence of events which carry with them their own unique environmental impacts, from mining the land, to chemically processing the ore, to piling the leftover discards onto the large mountainous waste piles known as phosphogypsum stacks (or "gyp stacks" for short). A good explanation of this whole process, from mining to disposal, is available at
http://www8.myflorida.com/environment/learn/waterprograms/wastewater/iw/phosphate.html

One of the more important points to bear in mind about the processing of phosphate rock is that it concentrates and makes more available the naturally present impurities - e.g. fluoride, uranium, radium, arsenic, cadmium, chromium, and lead - in the final waste slurry which is pumped on top of the phosphogypsum stacks.

The level, for instance, of fluoride in the wastewater hovers around 6,000 ppm (0.6%) according to one of the industry's chemical engineers at Farmland Hydro, L.P. This is an extremely toxic level of fluoride and a very signficant threat, if a leak occurs, to local water systems. (Less than half a liter of water containing 6,000 ppm fluoride is enough to kill a human being if swallowed.)

In the instances where this wastewater has spilled into local waterways, large fish kills have been reported, as described in the following two excerpts from the *St. Petersburg Independent* and the *Tampa Tribune*:

> "The specialists agreed yesterday - Bishop Harbor's illness is terminal . . . The fluorides are the final executioners for harbor life. For once the plant life is gone, with it goes the breeding grounds for new generations of marine life. And Bishop Harbor was a nursery for marine life, a mother for Tampa Bay's fish." *(Death of A Bay, St. Petersburg Independent, May 14, 1970)*

> "Heavy rains combined with shoddy maintenance of an overflow pipe were blamed for the 1997 spill of 54 million gallons of acidic water from the Mulberry plant into nearby wetlands and the headwaters of the Alafia River. The wave of acidic water killed untold numbers of fish all the way to its mouth at Tampa Bay.
>
> There are nearly 1 billion gallons of acidic water locked up in the treatment ponds in Mulberry, Zamani said. A spill of that magnitude into the Alafia River could be catastrophic, he said. And Piney Point contains half a billion gallons in its ponds. The plant lies just off Tampa Bay near Port Manatee, where a spill could kill anything alive in that portion of the Bay." *(Phosphate plants under close eye Tampa Tribune March 17, 2001)*

One way in which the phosphate industry works to reduce the level of fluoride in its wastewater is by capturing fluoride in its wet scrubbing systems and selling the captured fluoride solution as a chemical for fluoridation programs. According to the Florida Institute for Phosphate Research (1998), to "reduce fluoride in the process water by recovering the fluoride and using it for salable products" is currently an area of "strategic research" for the industry.

Along with trying to sell more of its fluoride waste, the phosphate industry is also researching ways of selling its phosphogypsum (e.g. as road base material). However, the radioactivity of the gypsum is currently serving as a major obstacle to this effort.

Included below are photographs, excerpts and links on 3 aspects of the phosphate industry - the chemical processing facilities in which refined, soluble phosphate is manufactured; the phosphogypsum stacks where the industry's waste is collected, and the mining of the land where the phosphate ore is derived. Also included is information on uranium exposure within the industry, information on sinkholes in the gyp stacks, and links for further reading.

-- Michael Connett

All of the photographs below, except as indicated, were taken by Michael and Paul Connett in Central Florida, the heart of the phosphate industry, in June 2001. They can be copied and distributed freely. Click on the photos to access larger copies of each.

Phosphate Processing Facilities

"Fluorine Recovery in the Phosphate Industry: a review" *Phosphorous & Potassium #103 SEPT/OCT 1979, pages 33-39.*

The fluorine compounds liberated during the acidulation of phosphate rock are now rightly regarded as a menace and the industry is now obliged to suppress emissions-containing vapors to within very low limits in most parts of the world. As with any pollution control operation, it is highly desirable for the operator of the fluorine scrubber to find a use or market for the recovered fluorine to help defray at least partially the cost of the operation.

EPA Calls for Reductions in Phosphate Industry's Fluoride Emissions (pdf file) *Federal Register Vol. 64, No. 111, June 10, 1999; 40 CFR Parts 9 and 60.*

SUMMARY: This action promulgates national emission standards for hazardous air pollutants (NESHAP) for new and existing major sources in phosphoric acid manufacturing and phosphate fertilizers production plants (SIC 2874). Hazardous air pollutants (HAPs) emitted by the facilities covered by this rule include hydrogen fluoride (HF); arsenic, beryllium, cadmium, chromium, manganese, mercury, and nickel (HAP metals); and methyl isobutyl ketone (MIBK)... Implementation of the rules will achieve an emission reduction of HF estimated at 315 megagrams per year (Mg/yr) (345 tons per year [tpy]). The standards will reduce 940 Mg/yr (1035 tpy) of total fluorides and particulate matter containing heavy metals which are regulated pollutants under the Clean Air Act as amended (the Act).

Letter from Rebecca Hanmer, EPA's Deputy Assistant Administrator for Water, 1983.

In regard to the use of fluosilicic acid as the source of fluoride for fluoridation, this agency regards such use as an ideal solution to a long standing problem. By recovering by-product fluosilicic acid from fertilizer manufacturing, water and air pollution are minimized, and water authorities have a low-cost source of fluoride...

Fluorides in the Air *Environment, Vol. 15, No. 3 April 1973*

WHEN A RANCHER sold 54 acres of his Garrison, Montana, land to the Rocky Mountain Phosphate Company it was a matter of civic pride. The new factory promised jobs and tax revenues for the industry-hungry region. Four years later, the Ponderosa pine and Douglas fir were turning brown, and the cattle on Garrison's ranches were so crippled they could not stand up. It took six years of vigorous and frustrating campaigning before the residents of Garrison succeeded in forcing the Rocky Mountain Phosphate Company to close permanently in January 1970. The story of Garrison is but one of many in which an industry and its neighbors have fought long and bitter battles over the damage caused by fluorides in the air.

Air Pollution from Stauffer Chemical Phosphate Plant *Ombudsman Report, Agency for Toxic Substances and Disease Registry, December 29, 2000*

From the instant the plant became operational, there were complaints of air pollution. In June 1948, less than a year after the plant's opening, eight local residents and landowners filed a nuisance suit (for gases and fumes) in the Federal District Court for Southern Florida, Tampa. Division (II-1). The suit alleged that fumes and gases from the operation were adversely impacting human health and plants, not only in the immediate area, but as far as 8 miles away...

Bartley Mickler stated in his deposition that since the plant opened, he had lost livestock. He indicated that he lost a lot of pigs and about 100 head of cattle. Mickler admitted that it is normal to lose cows in the winter months, about 10 per year, but he indicated that the past winter had been 200 to 300 percent worse.

Mickler also indicated that pine trees on his 5,000-acre property were affected by the plant. He indicated that in January or February 1948, he noticed pine needles turning red and brown and falling from the trees. His estimate was that at least half of the trees were impacted. New growth would bud and die back without being replaced... He carried samples of pine needles and palmettos to a Tampa chemist, who reported that some of the materials showed **300, 400, and 500 parts per million of fluorine...**

When asked , "Well from your experience of more than 30 years, did you form any opinion as to the cause of the discoloration of the pine needles and foliage at Tarpon Springs?" Claypool (an agricultural expert witness) answered, "In my opinion, it was caused by a gas or fume... I believe it was probably from a fluoride compound."

Phosphogypsum Stacks

Gypsum finds ecological concerns stacked against it *The Tampa Bay Business Journal December 6, 1996*

A main concern over the years, and a major challenge to the phosphate industry, are the gypsum stacks, most commonly seen dotting stretches of State Road 60 from the Bay Area east into the phosphate belt in the middle of the state.

Looking like giant loaves of bread, the stacks' bases can cover more than a square mile and rise a couple hundred feet into the air. These stacks contain a byproduct of phosphate manufacturing called phosphogypsum, with ponds at the top of the stacks where the phosphogypsum has been pumped as a slurry after the phosphate has been extracted.

While gypsum itself is a harmless material used extensively in products such as wallboard, the phosphogypsum stacks contain an acidic element that may cause concern when located near a drinking source. Also, phosphogypsum itself contains low-level radiation, which can be a source of radon gas.

Frequently Asked Questions *Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants - Subpart R: Radon from Phosphogypsum Stacks*

Why does the EPA regulate phosphogypsum?

Phosphogypsum contains radioactive material (radionuclides), which could potentially result in harmful exposure to radiation. Prior to processing, phosphate rock contains radium, uranium, thorium, polonium, and lead. Once the rock has been crushed and processed, the resulting waste has concentrated levels of these radioactive materials. Depending on the quality of the phosphate rock, the phosphogypsum could contain as much as 60 times the levels normally found prior to processing.

About Phosphogypsum *US Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants - Subpart R: Radon from Phosphogypsum Stacks*

In Central Florida, one of the major phosphoric acid producing areas, the industry generates about 32 million tons of phosphogypsum each year. They have a current stockpile in stacks of nearly 1 billion metric tons...The production of each ton of phosphoric acid is accompanied by the production of 41¦2 tons of the by-product calcium sulfate, also known as phosphogypsum.

How are the stacks formed?

The phosphogypsum, filtered from the phosphoric acid, is in the form of a solid/water mixture (slurry) which is stored in open-air storage areas known as stacks. The stacks form as the slurry containing the by-product phosphogypsum is pumped onto a disposal site. Over time the solids in the slurry build up and a stack forms.

Phosphate plants under close eye *Tampa Tribune March 17, 2001*

The complexities of keeping a phosphate processing plant operating are becoming clear to government regulators now overseeing two of them. Ponds full of 1.5 billion gallons of acid and three mountains of radioactive waste mean you just can't shut off the machinery and turn out the lights. The state could be stuck with the plants for years...When Mulberry Corp. told state environmental regulators in early February it couldn't afford to keep the plants running, it ignited fears of the potential for massive spills of highly acidic water into the Alafia River and Tampa Bay.

Mulberry bailout tops $1M *Herald Tribune June 17, 2001*

MANATEE COUNTY -- Florida taxpayers continue to pay thousands of dollars a day to prevent an environmental disaster at two bankrupt fertilizer plants, a report released this week shows... In a report to Manatee County Judge Janette Dunnigan, state-paid contractors overseeing Mulberry's Piney Point plant outlined how they've spent more than $640,000 since February to keep millions of gallons of acidic water from polluting groundwater or spilling into Tampa Bay... Closing the plant would require treating Piney Point's acidic water and covering massive stacks of radioactive phosphogypsum with a plastic liner, a move that could cost taxpayers an additional $15 million.






Phosphate Mining Operations

Council to send phosphate message: Feds should study impacts, resolution says *Sun Herald June 16, 2000*

Mike Flanders, a planning council member from Fort Myers, said he grew up in Polk County. "The Central Florida mining area is definitely among the most devastated land in Florida," he said.

Phosphate Mining Debate *Sun Herald*

A photo of Florida taken from the space shuttle Discovery shows what phosphate mining can do to a landscape. Viewed from above, Florida's metropolitan areas -- Miami, Tampa, Orlando -- stick out, a different color from the green and blue that covers most of the Sunshine State.

The phosphate mining area in Central Florida sticks out just as much. It's pockmarked with gray patches, the "moonscape" created when phosphate is taken out of the earth.

Up close, it's just as dramatic. Huge machines, called draglines, scoop up bucketfuls of dirt and phosphate, creating enormous holes in the ground.

Mining Threat *St. Petersburg Times Editorial June 20, 2001*

The Florida agency known as DEP needs a reminder that the P stands for protection, not permissiveness. Officials with the Department of Environmental Protection say they will approve a phosphate mining permit on 2,400 acres of ranch land in Manatee County, including part of a creek that feeds a public water supply and nourishes Charlotte Harbor's productive estuary.

Such permissive oversight might be understandable in West Virginia, where mining is king. In Florida, however, the destruction left behind by phosphate mining is increasingly incompatible with the state's key assets - clean water and unpolluted rivers and coasts.

Phosphate mining, which turns vast stretches of Florida into a sterile moonscape, has a poor environmental record. In 1971, 2- billion gallons of mining slime spilled into the Peace River and spread to Charlotte Harbor, 64 miles away. In 1991, two more spills contaminated the Peace River. And in 1997, an acid spill in the Alafia River killed more than a million fish and shellfish 35 miles away in Hillsborough Bay. IMC-Agrico had a dam break at a Hillsborough County mine in 1994, releasing a half-billion gallons of tainted water that killed cattle, flooded mobile homes and uprooted trees.

Toxic Ponds *Washington Post Photo Voyage*

Large clay settling ponds are created during the phosphate mining process...Filling with rainwater, the waste ponds are attractive to waterfowl. However, studies show that elevated levels of trace elements found in the pond water are hazardous to the birds' health.

Animal Poisonings on Reclaimed Phosphate Mines *Articles from Idaho State Journal July 2001*

Between 150 and 160 sheep died last month after drinking from a spring containing lethal amounts of selenium, a waste product of the phosphate mining process. The sheep, which belonged to Alicia Dredge, were grazing a stretch of private land located downhill from a reclaimed phosphate mine northeast of Soda Springs...

In addition to the sheep deaths last month, about 60 sheep died in the fall of 1999 after grazing near a mine dump northeast of Soda Springs, and in 1996, a herd of horses died as a result of selenium toxicosis.

OVERBURDEN: Phosphate Mining in Florida *Compilation of articles and editorials on phosphate mining from the Herald Tribune May 2001*

Spills frequent in phosphate mining *Sun Herald*

How Phosphate Mining is Done *Sun Herald*








Other Issues

Radiation Hazard

Handling of radium and uranium contaminated waste piles and other wastes from phosphate ore processing *Nuclear Science and Technology, Report EUR 15448 EN European Commission, Luxembourg 1995.*

Processing and waste handling in the phosphate industry is associated with radiation levels of concern for workers and the public. **The level of protection for these groups should be more similar to the level of protection that is state of the art in other industries, particularly the nuclear industry.**

Eastern Michaud Flats Contamination *Agency for Toxic Substances and Disease Registry, Superfund Site Assessment Branch, October 21, 1998*

Slag and gypsum pile workers may be exposed to elevated levels of alpha, beta, and gamma radiation. These exposures may increase the risk of a worker to develop cancer. However these exposures can and are significantly reduced by good occupational practices (e.g., shielding provided by vehicles and dust control), thereby significantly reducing the workers' risk of developing cancer.

Populations with Potentially High Exposures (to Uranium) from *Toxicological Profile for Uranium (Draft) US Agency for Toxic Substances and Disease Registry (ATSDR) September 1997,* p. 260.

Higher rates of uranium exposure have been reported for some populations... Industries where higher exposures to uranium are known to occur include uranium mining and milling, uranium conversion and enrichment, uranium fuel fabrication, and nuclear weapons production. Other groups with the potentially higher exposures include **persons involved in producing and using phosphate fertilizers** and individuals living and working near fossil fuel plants.

Atomic Energy Commission's Cold War Nuclear Contractors (See Florida; Joliet, Indiana; and Texas) *USA Today September 7, 2000*

Blockson Chemical: Extracted the better part of 2 million pounds of uranium from phosphate, 1965-62. Federal survey in 1977 found elevated radiation in soil and building; waste could not be segregated from that linked to commercial phosphate work

Cancer mystery deepens: Uranium secret, long ago in Joliet area, prompts questions *Suburban Chicago News October 1, 2001*

Following up on a USA Today investigation, the article mentioned that Blockson/Olin was one of about 200 private companies nationwide that had secret government contracts in the 1940s, '50s and '60s to produce uranium for weapons manufacturing.

So secret was it that the community, and even many Blockson employees, were unaware a radioactive material was being processed in Building 55 at the 1,000-acre plant on Patterson Road west of Brandon Road.

For about 10 years, from 1952 to 1962, Blockson-Olin produced about 2 million pounds of low-level uranium, a byproduct of phosphorus needed for cleansers, for the government.

'Yellow stuff'

Relatives of former employees said for years that if you worked at Blockson, you get cancer. Vince Driscoll and Ken Kurtz said their dads, who worked in Building 55, and other relatives who worked at the plant had cancer and/or died from it.

Since the Sept. 20 Herald News article, others have come forward as well to say their friends and loved ones died of lymphomas or lung cancer. But not all worked in Building 55, where the uranium was being extracted. Some couldn't remember where their relatives worked, and Olin officials are still looking for records.

Conner, who worked as a maintenance millwright at Blockson/Olin from 1950 to 1982, heard through the grapevine what was going on in Building 55. But he didn't have the necessary FBI clearance to go in. "We just knew they were taking some yellow stuff and bagging it up," he said.

Uranium Production Capacity of IMC-Agrico *Operating Status of Nonconventional Uranium Plants, Department of Energy, 2000*

Table 7. Operating Status of Nonconventional Uranium Plants, End of the Year 2000				
Plant Owner(s)	**Plant Name and State**	**Plant Type**	**Rated Capacity[a]** (thousand pounds U_3O_8 per year)	**Operating Status at the End of the Year[b]**
IMC-Agrico	Sunshine Bridge (LA)	Phosphate Byproduct	420	I (CP)
IMC-Agrico	Uncle Sam (LA)	Phosphate Byproduct	750	I (CP)
IMC-Agrico	Plant City (FL)	Phosphate Byproduct	608	I (CP)
IMC-Agrico	New Wales (FL)	Phosphate Byproduct	750	I (CP)
a *Milling capacity based on data reported on Form EIA-858 for 2000*				
b *I=Inactive at the end of the year. CP=Closed permanently (will not be restarted)*				

Note: *In December of 1998, IMC Agrico ceased its commercial production of uranium due to uranium's declining market price. Up to that point, however, IMC Agrico was producing - from its two processing facilities in Louisiana - 16% of the uranium produced annually in the US (950,000 pounds/year). See http://www.antenna.nl/wise/uranium/umopusa.html#IMCLA*

Yellowcake Production at Stauffer Chemical *from Agency for Toxic Substances and Disease Registry, Ombudsman Report of Findings and Recommendations Regarding the Stauffer Chemical Company Site Tarpon Springs, Florida, December 29, 2000*

On January 27, 1987, Jack Lawson, of the Clearwater Sun, wrote a story entitled "Uranium was extracted at Stauffer plant," indicating that in the 1970s, Stauffer let another company extract and recover the small amounts of uranium remaining in processed ore at the plant. (142) Such extracted uranium, commonly called yellow cake, can be used in the powering of power plants or in the production of nuclear bombs.

The ombudsman spoke to Lawson twice. The journalist stands by the story and has an amazing recollection of the related details. His story was based upon two sources, McCall, a public health officer for FDHRS (142) and Fred Thompson, with the State Department of Transportation (DOT). (143)...

However, McCall recanted the story the next day. Lawson indicated that in addition to the story being recanted, executives of Chesebrough-Ponds, the company that owned the site at the time of the story, descended upon the Clearwater Sun, seeking a retraction. However, the editor refused to retract the story because of two corroborating sources. There are rumors that McCall was forced to recant the story out of fear of losing his job and/or his retirement benefits. On August 2, 2000, McCall told the ombudsman, in a non-committal way, "I have no memory of it, I don't think it was done."

Radium Content of the Phosphogypsum *Strategic Assessment of Florida's Environment (SAFE)*

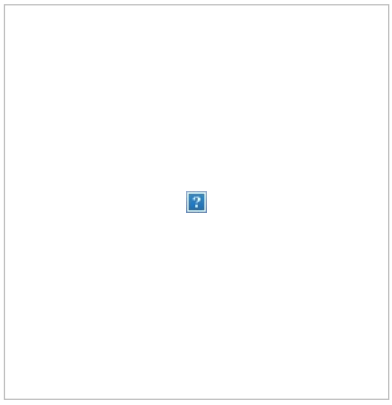
The radium content of phosphogypsum is 20 to 30 picoCuries Ra-226 per gram (pCi/g), whereas the radium content of most soils and rocks, and of natural gypsum, is on the order of 1 to 2 pCi/g or less. This radioactivity is generally perceived by the public as the major problem with its use. Radon gas and the daughter products of radon decay become the products of concern following the decay of radium.

(Sinkhole in IMC Agrico's New Wales Gypsum Stack - photo from Save our Springs Inc)

Sinkholes in the Gypsum Stacks

IMC Agrico's New Wales Sinkhole *Charlotte Harbor Magazine*

State regulators' "worst nightmare" happened in June 1994 when a cavernous hole, 106 ft. wide by 185 ft. deep, opened in the center of an IMC-Agrico waste stack near Mulberry, Fla., like a scene out of Jules Verne's "Journey to the Center of the Earth." The sinkhole, shown in photo taken July 13, 1994, at IMC-Agrico's New Wales plant released 20.8 million pounds of liquid phosphoric acid into the ground below. The company was able to clean up the spill before it harmed the drinking water supply, regulators say."



(Sinkhole in New Wales Gypsum Stack - AP Photo/Selbypic)

Sinkhole in Gypsum Stack Update *John Cameron, IMC - Agrico May 25, 1996*

On June 27, 1994, an erosion sinkhole occurred in the 200-foot-high phosphogypsum storage area at the New Wales plant at IMC - Agrico Company in Polk County Florida. The hole measured 160 feet in diameter at the surface. The hole was repaired by grouting with specially formulated concrete mix. Remediation activities were successfully completed in April 1995 at a cost of $6.8 million.

Response to Water Quality Crisis at New Wales *Bill Erickson, PECO May 25, 1996*

In June of 1994 a sinkhole formed under the plant's original gyp stack. A portion of the gypsum and contaminated pond water stored above the sinkhole fell through the sinkhole into the underlying aquifer. The incident was reported to the Florida DEP. Use of the original gyp stack was discontinued until effects of the sinkhole could be identified and corrected...This paper reviews the water management measures used at New Wales used to deal with the deteriorating water quality during the sinkhole crisis. The gyp stack sinkhole was plugged in March 1995, and the well water quality has gradually improved.

Further Reading:

* **Fluoride-tainted Pasture Grass May Harm Cattle** *Tampa Tribune February 16, 1984*

* **Hamilton County: Death in the Air** *George Glasser April, 2001*

* **EPA to Review Contamination from Phosphate Industry in Ohio** *Environmental News Network July 13, 2000*

* **Phosphate Fertilizer Pollution in Israel (Haifa Chemical)** *Greenpeace June 8, 1998*

* ***Greenpeace*** **Action Alert on Phosphate Industry Pollution in Mediterranean** *Greenpeace Mediterranean September 21, 2000*

* **European Companies Find Alternative Means of Disposing of Fertilizer Industry's Fluoride Effluent** *Presentation at the International Fertilizer Industry Association's Technical Conference, New Orleans, 2000*

* **Environmental Coalition Joining Phosphate Fight** *Herald Tribune May 20, 2001*

* **Opposition Builds to Stop Mine** *St. Petersburg Times June 18, 2001*

* **Pivotal hearing on mining to begin** *Herald Tribune July 22, 2001*

* **Phosphate Companies Head Florida Pollution List** *The Gainesville Sun May 14, 1999*

* **Phosphate Industry Superfund Site in Idaho** *Agency for Toxic Substances and Disease Registry, Superfund Site Assessment Branch, October 21, 1998*

* **Article Archive on Phosphate Industry** *Herald Tribune (Sarasota, Florida)*

* **Ombudsman Report on Stauffer Chemical** *Agency for Toxic Substances and Disease Registry, December 29, 2000*

* **Dartmouth Professor Warns of Chemicals Added to Drinking Water** *Dartmouth News March 15, 2001*

* **A Resolution on the Silicofluoride Controversy** *Dr. Robert Carton & Myron Coplan, 2001 (Resolution submitted to the American Public Health Association for consideration at October 21-25, 2001 conference in Atlanta, Georgia)*

* **The Official Spinning of Pollution into an Elixir** *George Glasser 2000*

* **How Much Arsenic is Fluoridation Adding to the Public Water Supply?** *Fluoride Action Network October 2000*

* **Fluoride Air Emissions from Phosphogypsum ponds** *Report from Terra Air Services/Petris Technology, Houston, TX*

* **Tonnage of Phosphogypsum Generated** *Strategic Assessment of Florida's Environment (SAFE)*

* **Fluoride Pollution: An Overview** *Fluoride Action Network May 2001*

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