Novaphos LLC
3200 County Road 630 West
Fort Meade Florida 33841
www.novaphos.com

To: **Agricultural Marketing Service**
US Department of Agriculture ("USDA")

From: **Novaphos, Inc.**

Date: **14 May 2022**

Re: **Access to Fertilizer: Competition and Supply Chain Concerns**
Request for Public Comments (the "Request")
Docket number: AMS-22-0027

Summary

Phosphates are one of the most important fertilizers used by American farmers. US production of phosphate fertilizers has dropped as a result of industry consolidation, lack of raw material availability, and environmental and permitting pressures. Import limitations have compounded these circumstances, and phosphate prices are now at record highs. The security of the long-term US supply chain for phosphates is at risk, which could jeopardize US agricultural productivity. Novaphos can address these issues by making phosphoric acid for US farmers: locally, sustainably and economically. Novaphos is a US-based company with proprietary technology to produce phosphoric acid—the key building block for phosphate products—from low-grade ore and even recycled mine waste tailings. Our "green" process does not produce large volume wastes like the phosphogypsum that is a major disposal burden for existing producers; rather, we produce useful and safe coproducts. The phosphoric acid we produce is high quality, suitable for more sustainable, precise fertilization practices. Novaphos intends to seek a USDA grant of up to $5m, which will be combined with the significant investments made by our private-sector partners to enable deployment of Novaphos technology. We plan to use this funding to accelerate construction of commercial-scale Novaphos production facilities in the US, adding up to 20% to the US supply of liquid phosphate fertilizers over the coming 3-5 years, with additional Novaphos plants to be constructed thereafter. With USDA support, Novaphos can address the phosphate supply chain crisis for US farmers highlighted in the USDA Request.

USDA Question 1

Please describe challenges and concerns with market concentration and power in the fertilizer industries, including the extent of control by any firms over farmers' and business' access to fertilizer, pricing, availability, transportation and delivery, quality, and any other contract terms or other factors. Please describe how these challenges have developed or evolved over time, and any details on geographic or other divergences within various regions of the United States or between the United States and international markets for fertilizer.

Raw material unavailability, permitting difficulties and offshore competition have driven large reductions of US phosphate capacity and heavy consolidation among competitors.

As background, note that phosphates are one of the most important fertilizer nutrients and essential to modern intensive agriculture as practiced on many American farms. There can be no substitution for phosphates by other nutrients, e.g. nitrogen or potash, and without continued application of phosphates, crop yields will drop very significantly. [1]

Almost all phosphate fertilizers are produced from mined phosphate rock, which is chemically transformed into fertilizer through the "wet-acid process" (see graphic on the next page) after the phosphate rock ore has been upgraded at the mine (i.e. beneficiation), a process which generates large quantities of mine tailing wastes that still contain useful phosphate. In the process of chemically transforming phosphate rock into phosphoric acid, the wet-acid process also produces more than five tons of waste phosphogypsum for each ton of phosphate. Phosphogypsum disposal difficulties have led to numerous environmental incidents and plant closures in the US and around the world.

The number of process units that comprise a wet-acid plant necessitates building large plants with annual capacities of 0.4-0.5 million metric tons P_2O_5[2] each and very high capital costs. Each plant must be supplied from a mine based on a very large deposit of high-quality phosphate ore. There are very few available phosphate ore deposits in the world that can economically supply a wet-acid plant; they are essentially non-existent in the US.

The US phosphate fertilizer production sector has seen significant consolidation: in 2000 there were 11 phosphoric acid producers with 12.0m mt of capacity,[3] all using the wet-acid process. By 2021, there remained only four US phosphate producers with 7.5m mt of capacity. One producer, Mosaic, controlled 60% of capacity. Imports—together with declining US exports—have helped to offset some of this reduction in domestic supply, but recent events have reduced imports and increased importation costs (see response to Question 8 below).

Phosphate industry consolidation has been even more pronounced in the liquid fertilizer part of the market, which depends on the production of higher cost superphosphoric acid ("SPA"), where the number of producers has dropped from five to three. Although imports have helped address US solid phosphate fertilizer supply needs, they have had almost no impact on the SPA market.

---

[1] These comments to the Request will focus only on the fertilizer part of the US phosphate sector, since this is the focus of the Request, although other uses of phosphates are important to the US economy and policy objectives of the US government, such as animal feed phosphates and industrial phosphates, including in LFP cathode material for lithium-ion batteries. For example, see the *National Blueprint for Lithium Batteries* published in June 2021 by the Federal Consortium for Advanced Batteries, where phosphates for LFP battery cathodes are relevant to Goal 1: "Secure access to raw and refined materials and discover alternatives for critical minerals for commercial and defense applications;" and Goal 2: "Support the growth of a U.S. materials-processing base able to meet domestic battery manufacturing demand"

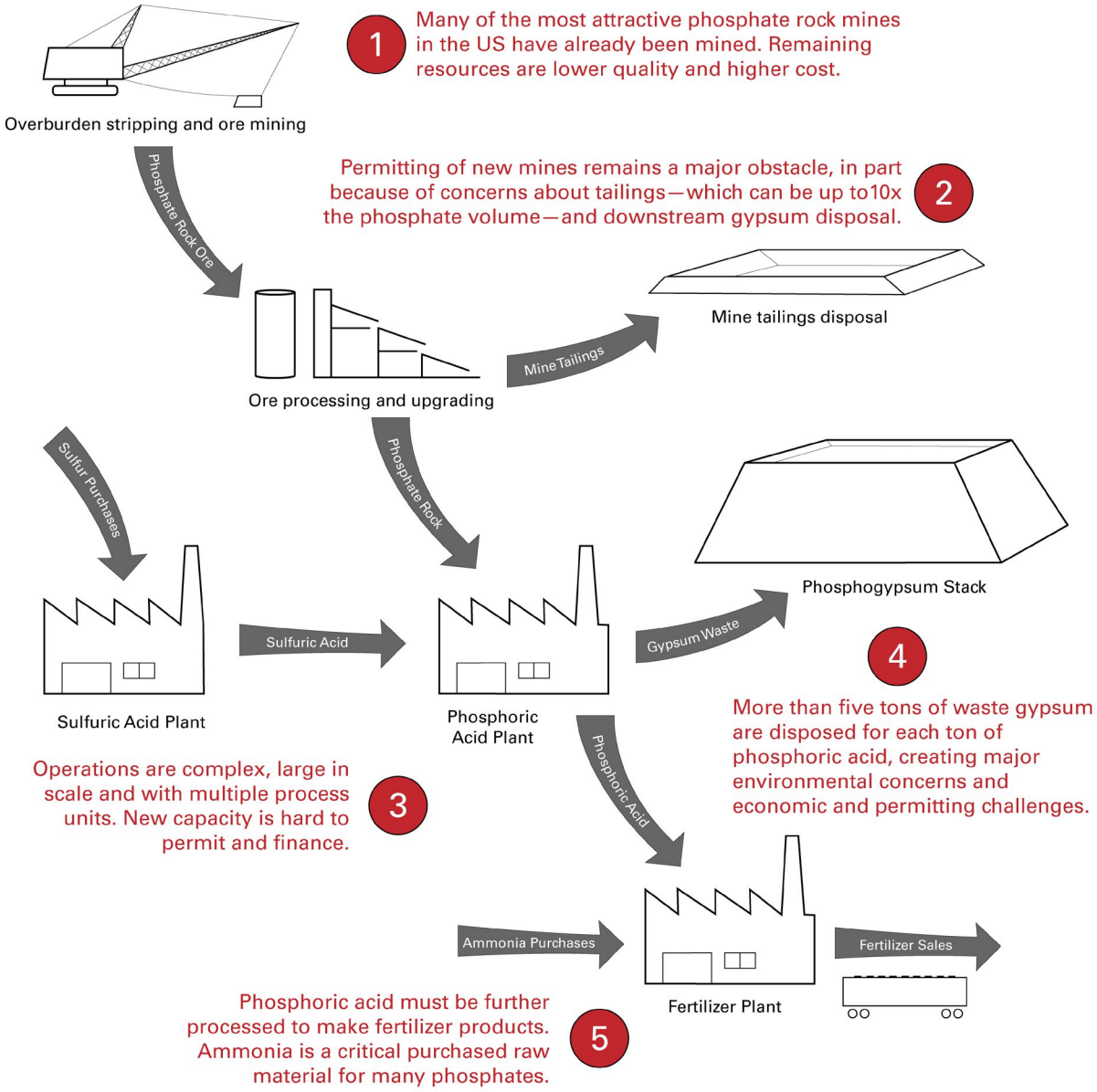
[2] All references here to volumes will be to metric tons of P_2O_5, the industry standard for describing the phosphate content of fertilizers.

[3] Note that phosphoric acid capacity typically operates at about 80%. All market data from CRU.

The major factors driving this reduction of US capacity have been:

- Depletion of economic, permitted phosphate rock mineral resources.
- Limitations on phosphogypsum disposal.
- Development of lower-cost offshore sources, e.g. in Morocco and Saudi Arabia.

Wet Acid Phosphate Fertilizer Production



USDA Question 8

Please comment on the U.S. agricultural system's reliance on foreign supply of some fertilizers and global supply chain risks that could result from trade disruptions. Please comment on how the conflict in Ukraine may be impacting fertilizer markets. If other supply chain or trade disruptions have been experienced, please describe the effects and challenges in dealing with such events. Would greater availability of domestic or North American options mitigate risks? Would reducing dependence on suppliers from any one country or region mitigate risks? What tools might be deployed to achieve those ends?

The US phosphate sector has progressively become dependent on imports, increasing supply chain vulnerability.

The US has moved from being a net exporter of phosphate fertilizers of about 5m mt in 2000 to being a net importer in 2021, and this change in trade balance has mitigated the US capacity curtailments described above. A number of recent events have disrupted availability of phosphate imports to the US. These have included Chinese export controls, US FTC anti-dumping tariffs, and the war in Ukraine.

The war in Ukraine is having both a direct and indirect impact on phosphate supplies. First, Russia was a major exporter of phosphate fertilizers, and those exports have now effectively ceased. Second, Russia and its neighbors were also sources of important phosphate raw materials: sulfur and ammonia. The war has disrupted Russian supplies and blocked the traditional shipping routes for these products through the Black Sea. Finally, curtailments of Russian natural gas supplies to Europe have caused ammonia producers in Europe to reduce production, further exacerbating the supply crunch. All of these factors are affecting global and US production capacities and costs.

Increased US-based production of phosphates would mitigate import dependency, particularly if based on raw materials that could be sourced within the US. As noted above, phosphate rock resources for wet-acid producers in the US are highly limited and tightly controlled. The Novaphos process can use much lower grade phosphate rock and can recycle mine waste tailings. Moreover, the Novaphos process does not consume sulfur or ammonia.

Widespread adoption of the green Novaphos process would reestablish domestic phosphate production and reduce imports.

USDA Question 9

Please comment on sustainability, climate, and other environmental concerns and risks relating to fertilizer markets. Have market concentration and power exacerbated these challenges and risks? Have they facilitated sectoral adjustment for climate and sustainability purposes? Would shifting fertilizer production to countries with high standards on labor and environmental protection improve competition, better manage sustainability risks, or otherwise improve public interest outcomes? What other strategies may exist to raise sustainability standards along supply chains?

Phosphate production using the wet-acid process has major environmental impacts that have had a direct, negative impact on US production. The Novaphos process is "green" and avoids these issues, enabling long-term self-sufficiency and greater competition with the US phosphate sector.

The biggest environmental sustainability challenges for the US phosphate sector are:

- Limited and dwindling remaining resources of high-grade phosphate rock.
- Generation of large volumes of mine tailings wastes.
- Disposal of phosphogypsum waste.[4]
- Production of more efficient application of phosphate fertilizers to reduce run-off, which requires even higher-grade phosphate rock for wet acid phosphate fertilizer production.
- Logistics required to transport fertilizer from production facilities to farms adds to its GHG footprint.

Technology already exists to directly address all of these themes—the Novaphos process:

Resource efficiency: Novaphos can use low-grade phosphate rock that cannot be used in the wet-acid process and is currently left unmined or is discarded. There are significant low-quality phosphate resources in the US that Novaphos can use as raw material.

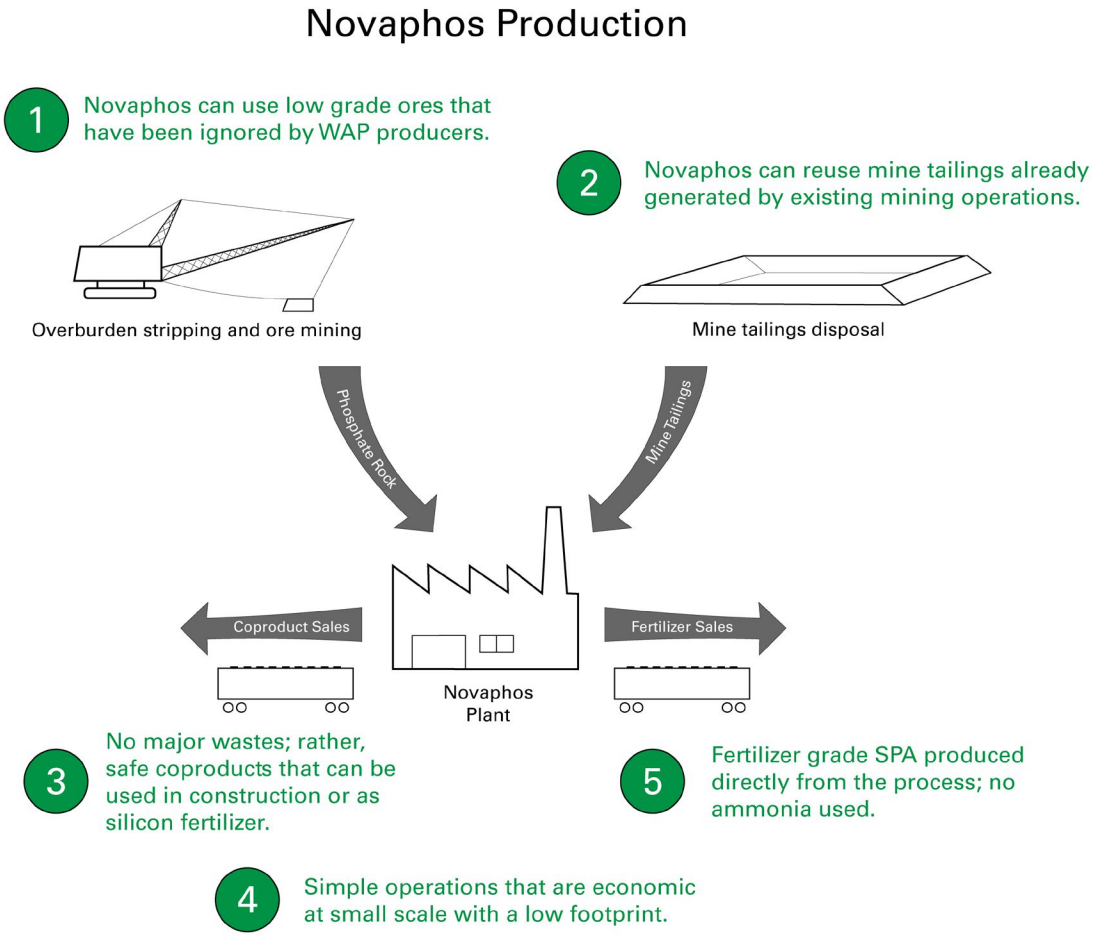
Recycling: Novaphos can consume stockpiled and new mine tailing wastes and reduce future generation of mine tailings. These tailings can never be used by existing wet-acid plants because of quality constraints.

Green process: Novaphos does not produce phosphogypsum; rather a calcium silicate coproduct—called J-Rox™—useful in construction as a replacement for cement and aggregate, as well as a silicon fertilizer—and with a net negative GHG footprint.

Precision fertilization: Novaphos makes SPA and other higher grades of phosphoric acid, suitable for liquid fertilizers, which can be used more precisely with less waste and less polluting runoff.

Small, local production: The Novaphos process is much simpler and less capital intensive than the wet-acid process, making small plants economical. Small plants can exploit small deposits of lower quality phosphate ore, which are more prevalent than the large, high-quality deposits required by the wet-acid process.

[4] The cost and difficulty of complying with federal regulations and enforcement initiatives concerning phosphogypsum disposal have caused several US plants to cease manufacturing phosphoric acid (e.g. Pasadena, TX and Geismar, LA, both of which produced SPA) and will certainly curtail the remaining life span of other existing operations. The Novaphos process does not produce phosphogypsum; moreover, a second Novaphos technology can reprocess phosphogypsum generated by wet-acid producers, which will help these producers extend the lifespans of current production facilities.



USDA Question 10

What obstacles exist to the financing and development of new fertilizer capacity that would enhance the competitiveness of fertilizer markets? Would new or expanded domestic manufacturing, mining, processing, or alternative fertilizer production capacity help promote access to and affordability of fertilizer for agricultural producers? Are there existing "shovel ready" manufacturing, mining, or other processes that could or should be adjusted to facilitate new fertilizer production? Are there other potential new entrants in the near or medium-term? How might USDA best support investment in new fertilizer capacity in the U.S.?

Novaphos is a unique, "green" solution to producing more US phosphates locally, sustainably and economically. Combining USDA support with Novaphos' private sector resources will accelerate deployment of Novaphos technology.

With assistance from USDA Novaphos can expedite building its first commercial plants to produce phosphoric acid in the US based on low-grade phosphate rock and existing mine tailings. Such plants would represent new entrants into the US phosphate fertilizer market, both increasing the amount of phosphate made domestically and the number of local competitors. At the same time, the Novaphos

process can significantly improve the environmental profile of the US phosphate sector, avoiding new wastes, recycling existing wastes and reducing its GHG footprint.

Building new phosphate mines and wet-acid plants is expensive, time-consuming and faces heavy regulatory challenges (e.g. phosphogypsum disposal). No new plant has been built in the US for many years; rather, numerous domestic plants have been permanently shut down. For these reasons—poor economics, phosphate rock resource limitations and permitting challenges—no new wet-acid plants are likely to be built again in the US.

With Novaphos technology:

- The US can develop supplies of phosphates from domestic resources that cannot be used by current industrial processes, enabling new end-to-end production of phosphates within the US for many years to come.

- Production of waste phosphogypsum or other large waste products can be avoided and replaced with co-production of a calcium silicate product—called J-Rox™—useful in construction as a replacement for cement and aggregate, as well as a silicon fertilizer.

- New competitors will be able to enter the US market (e.g. by taking advantage of low-grade phosphate rock resources not controlled by existing producers).

- Direct production of high-quality phosphoric acid as SPA suitable for use in more sustainable and less polluting liquid fertilizers will increase with greater competition.

- Overall greenhouse gas emissions can be reduced (e.g. with the offset from avoided cement production).

- Plants can be deployed efficiently at much smaller scale, with US production closer to US consumers, reducing logistics costs and environmental impacts.

- Productions costs will drop, implying lower costs for phosphates for American farmers.

Novaphos intends to seek a grant from USDA of up to $5m. The use of this grant will be to complement existing private-sector support being used by Novaphos to effect commercial deployment of its technology. Critical tasks that a USDA grant would help to accelerate are detailed engineering, permitting, and site acquisition and development.

Novaphos anticipates that its first commercial plants will add up to 20% to the supply of SPA for liquid phosphate fertilizers and be in operation within 3-5 years. Additional Novaphos plants to be constructed thereafter to add further to the US supply of phosphates, including for solid phosphates.

With USDA support, Novaphos can address the phosphate supply chain crisis for US farmers highlighted in the USDA Request.