February 7, 2024

Jonathan P. Walsh
Radiation Protection Division
Office of Radiation and Indoor Air, Environmental Protection Agency
Environmental Protection Agency
1200 Pennsylvania Ave. NW
Washington, DC 20460
Via electronic mail: walshjonathan@epa.gov

Re: Request for Approval of Use of Phosphogypsum in Small-scale Pilot Project; November 27, 2023, Meeting; Response to Questions

Dear Jonathan,

We want to thank you and the other representatives from EPA for meeting with us on November 27, 2023, to discuss Mosaic Fertilizer, LLC's ("Mosaic") pending request for approval to use phosphogypsum (PG) in a small-scale pilot project on Mosaic's property.

As background, on March 31, 2022, Mosaic submitted a Petition requesting approval under 40 C.F.R. §61.206 to remove phosphogypsum ("PG") from a phosphogypsum stack at the Mosaic New Wales facility and utilize the PG to perform a small-scale pilot road project at another location at the New Wales facility. The University of Florida would lead the research, consult on the project, and provide the performance testing and evaluation of the demonstration project, which would occur on land Mosaic owns.[1] The purpose of the project is to demonstrate the use of PG as feedstock in road base as an approved alternative to the current regulatory requirement that PG must be stored in stacks.[2]

On June 30, 2023, the Governor of Florida signed into law HB 1191 directing the Florida Department of Transportation ("FDOT") to study the use of PG in aggregate material used in road construction.[3] On August 23, 2023, Mosaic supplemented the Petition to add longer test segments and inclusion of an additional aggregate mix. The supplement included an updated risk assessment that concluded the modest project changes do not alter the risk assessment conclusions supporting the Petition.

We are providing the enclosed additional information in response to questions raised during our discussion. We've also included a copy of the meeting slides, per your request.

Mosaic Responses to EPA's Areas Identified for Further Discussion and/or Documentation

1. *Results of laboratory leach testing (LEAF), total elemental and leachable concentrations of constituents of concern*

[1] See Request for Approval of Additional Uses of Phosphogypsum Pursuant to 40 C.F.R. §61.206 *Small-Scale Road Pilot Project on Private Land in Florida*, submitted by Mosaic Fertilizer, LLC, March 31, 2022.
[2] 40 C.F.R. § 61.206(a)-(c).
[3] H.R. 1191, 125th Leg. Reg. Sess. (Fla. 2023).

Total element analysis and several laboratory leach tests including the EPA Leaching Environmental Assessment Framework (LEAF) methods 1316 and 1313 were performed on the proposed PG- amended road base blends. Methodology, total and leaching behavior results associated with the LEAF methods are included in the attached report in Sections 4.0, 5.1, and 5.2.

Results from these analyses were compared to EPA Regional Screening Levels (RSL) and Florida Groundwater Cleanup Target Levels (GCTL), and concentrations exceeding respective thresholds used to identify constituents of potential concern. Total concentrations from all trace metals evaluated remained below the industrial and residential thresholds, except for As which narrowly exceeded the residential threshold but remained within the range of As naturally observed in Florida soils and other road base products. Constituents that leached from LEAF methods above the respective screening limit in at least one mix design include fluoride, sulfate, molybdenum, and strontium and were identified as constituents of potential concern. It is important to note these values do not represent predicted groundwater concentrations and an exceedance does not prohibit a material from reuse, as site-specific dilution and attenuation from the subsurface environment and road base conditions can influence behavior. The identification of these constituents in the bench testing allows for focused evaluation of specific elements within the suite of analyses. The fate and transport of these constituents are evaluated further in Section 8.0.

2. *Groundwater screening modeling (IWEM) results, calculation of dilution attenuation factor*

Required dilution and attenuation of constituents from infiltration through the road base by sub surface and aquifer prior to a point of compliance were calculated using the highest leaching values yielded over all L:S ratios. The dilution and attenuation factor, or DAF, is calculated by dividing the concentration observed with the target water quality threshold. For each constituent of potential concern, the highest DAF calculated was 6.8 as discussed in Section 8.1 of the attached report, suggesting that the concentration in the infiltration through the road base would require a 6.8 times reduction via dilution and attenuation to reach target quality thresholds at a point of compliance.

Estimated concentrations of constituents of potential concern (fluoride, sulfate, molybdenum, and strontium) were calculated in IWEM at 10ft, 50ft, and 100ft from the road (mg/L) for each proposed mix design. The IWEM input parameters and modeling approach are detailed in Section 8.1 and 8.2. Site-specific data from Polk County and the Mosaic pilot project site were used in fate and transport analysis. Appendix D includes a sample of IWEM data from the PG:LR blend. IWEM input parameters include site-specific data, regional data, and infiltration rates calculated with the HELP model. At each receptor location, concentrations are below water quality thresholds, indicating the target DAF was reached, as discussed in Sections 8.3 and 8.4.

3. *Groundwater study design, including rationale for 18-month duration*

The groundwater study includes installation of groundwater wells upgradient and down gradient of each test section. Each test and control section includes one upgradient and two down-gradient wells, for 24 groundwater monitoring wells along the project's length. Background soil from four locations corresponding to each test section and groundwater concentrations from each of the 24 wells will be collected before construction. Measured analytes include pH, oxidation reduction potential (ORP), turbidity, heavy metal and anion concentration, and radionuclide concentrations.

As discussed in Section 9.0, following construction, samples will be collected from each of the 24 groundwater monitoring wells quarterly for 18-months, whereupon the sampling timeline will be reassessed.

4. *Lysimeter study design, pore volume of road base, and anticipated residence time of water*

Leachate collection devices (lysimeters) will be installed under each section of the road base to collect infiltration directly from it (for 8 lysimeters). The volume of the leachate will be collected to provide in-situ infiltration rates of asphalt and PG-amended base. The leachate samples will also be analyzed for constituent concentration (heavy metals, anions, radionuclides), and compared to screening water quality thresholds. Consistent with the groundwater analysis, the lysimeter data will be analyzed at the end of 18 months and assessed. Appendix E includes example CAD drawings of lysimeter installation for monitoring purposes.

Per typical road construction design, the road base is compacted at optimum moisture content during implementation to reduce settling and maximize bearing strength. The permeability of compacted PG-amended specimens was measured in the laboratory. The average hydraulic permeability measurements for PG-LR and PG-RCA are 2.19*10E-06 and 6.84*10E-06 cm/s. The infiltration assessment is presented in Sections 7.1, 7.2, and 7.3 of the attached report.

5. *Consideration of chemical forms of carbon and effects on redox in groundwater and lysimeter studies, whether dissolved organic carbon can be measured*

Groundwater sampling procedure is designed to minimize effects of sampling on redox potential of the sample and allow for measurement of oxidation-reduction potential and dissolved organic carbon. The focus of this study is to measure the constituent concentrations in the groundwater monitoring wells or lysimeter collection points using naturally occurring chemical forms of carbon.

6. *Any relevant publications to date, or historical data of phosphogypsum roads that pre-date regulation*

Included as a separate attachment.

DocuSigned by:
Pat Kane
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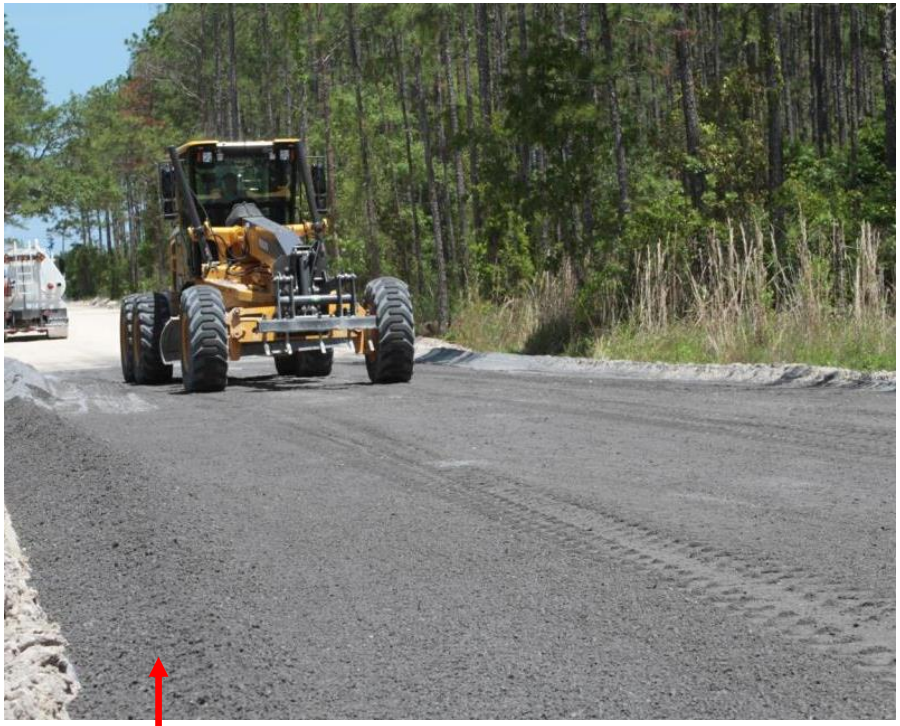
2/7/2024 | 11:10:40 AM PST

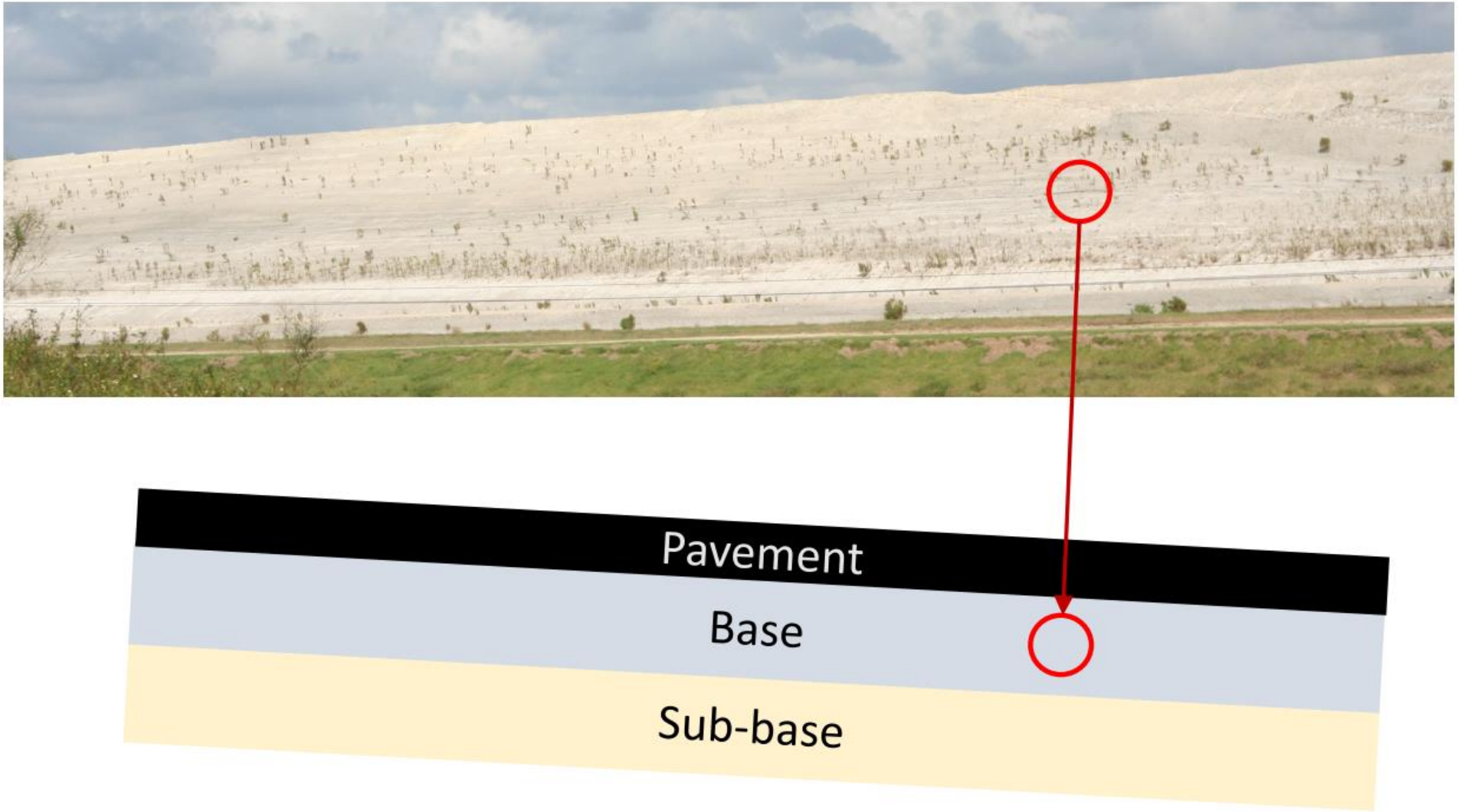
Regards,
Pat Kane – Vice President EHS
Mosaic Fertilizer, LLC

Pilot Project using Mosaic PG in Road Base

- Pilot Objectives
  - Evaluate the use of PG as an ingredient in a blended road base
  - Compare different road base mix design options
  - Validate laboratory performance measurements in field
  - Collect data to assist in future PG recycling efforts

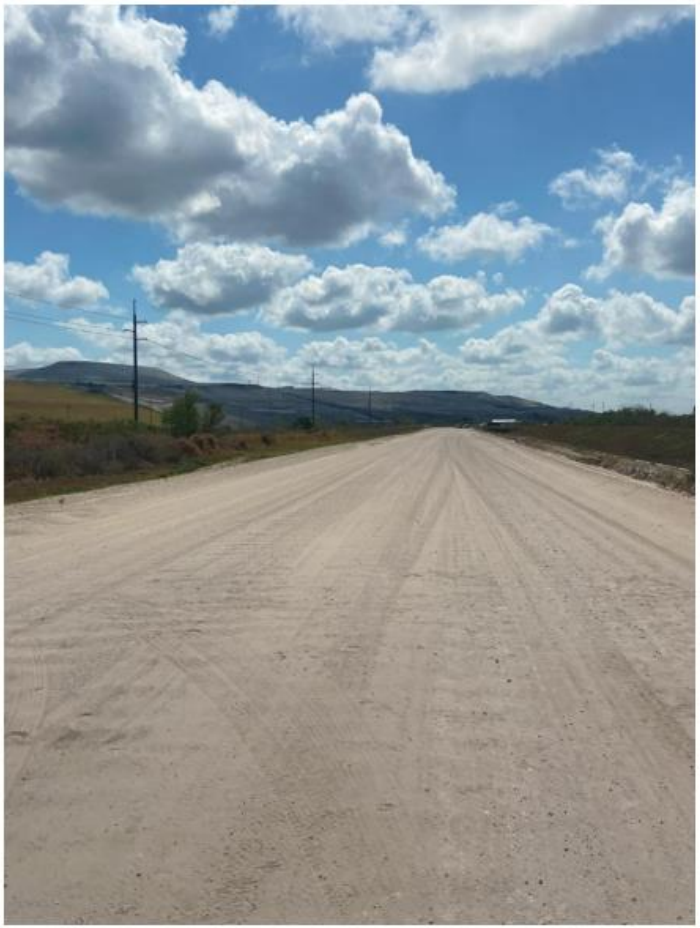


Previous pilot beneficial use project using processed MSW incineration ash permitted through Florida Department of Environmental Protection

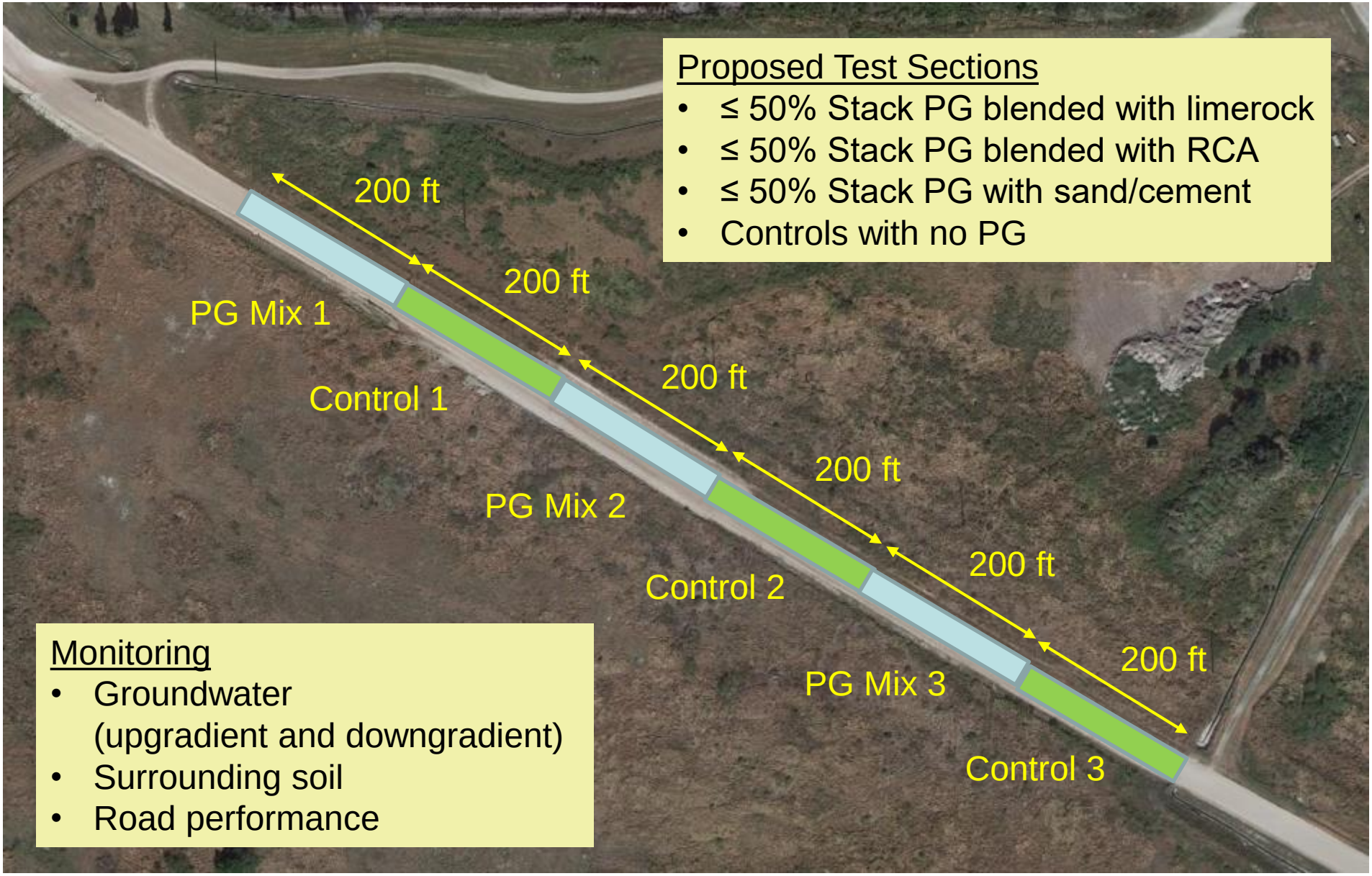

Pavement
Base
Sub-base

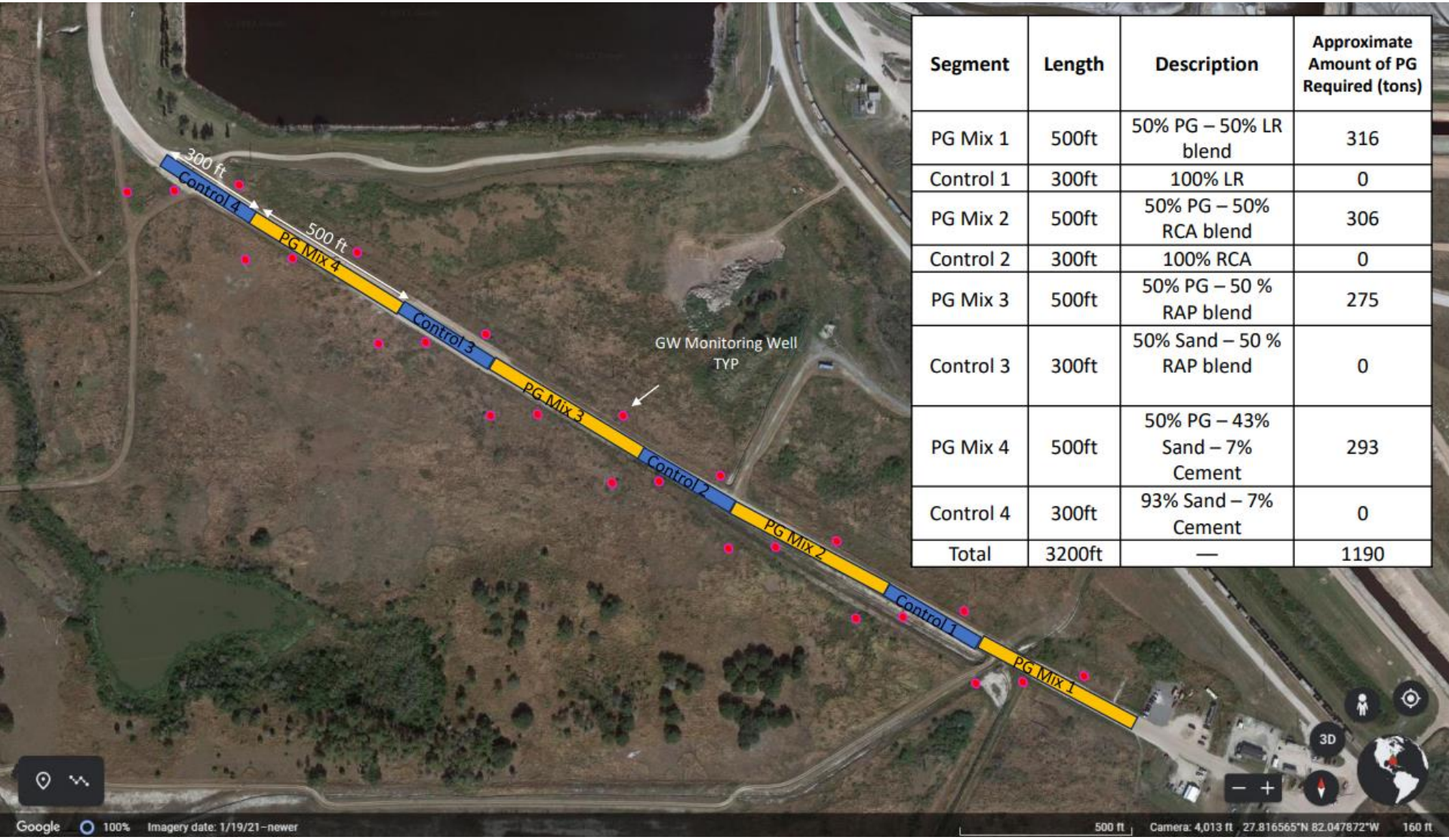
Project Background: Site Information

- Mosaic New Wales Facility
- South of stormwater retention pond
- Section of unpaved road to be used for demonstration project



Original Plan





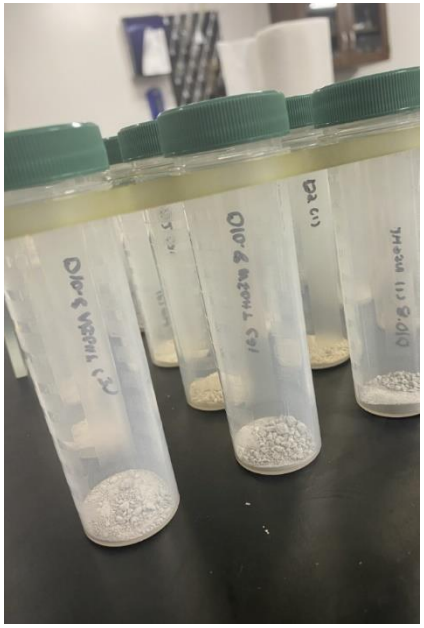
Segment	Length	Description	Approximate Amount of PG Required (tons)
PG Mix 1	500ft	50% PG – 50% LR blend	316
Control 1	300ft	100% LR	0
PG Mix 2	500ft	50% PG – 50% RCA blend	306
Control 2	300ft	100% RCA	0
PG Mix 3	500ft	50% PG – 50 % RAP blend	275
Control 3	300ft	50% Sand – 50 % RAP blend	0
PG Mix 4	500ft	50% PG – 43% Sand – 7% Cement	293
Control 4	300ft	93% Sand – 7% Cement	0
Total	3200ft	—	1190

Performance Characterization

- Gradation
- Proctor compaction
- Limerock bearing ratio
- Unconfined compressive strength
- Mix design optimization

Environmental Characterization

- Total element concentrations
- Leachable concentrations
  - Metals
  - Ions
  - Radionuclides



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Leaching Environmental Assessment Framework (LEAF) Methods and Guidance

Beneficial Use Risk Assessment

- BUD following standard protocols from EPA and FDEP
  - Direct exposure pathway
  - Leaching-to-groundwater pathway

Environmental Science & Technology

Article

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Material- and Site-Specific Partition Coefficients for Beneficial Use Assessments

Nawaf I. Blaisi,[⊥] Kyle A. Clavier,[†] Justin G. Roessler,[†] Jaeshik Chung,[†,‡] Timothy G. Townsend,*[,†] Souhail R. Al-Abed,[§] and Jean-Claude J. Bonzongo[†]

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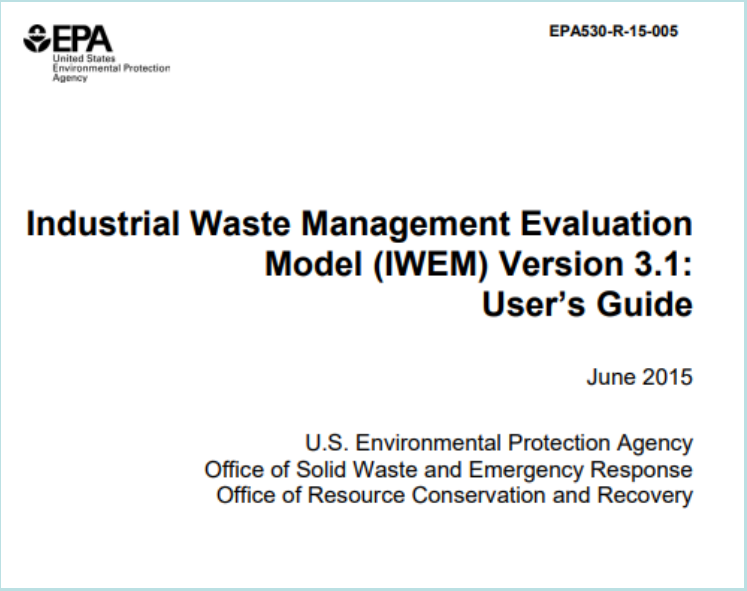


EPA United States Environmental Protection Agency

EPA530-R-15-005

Industrial Waste Management Evaluation Model (IWEM) Version 3.1: User's Guide

June 2015

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Office of Resource Conservation and Recovery

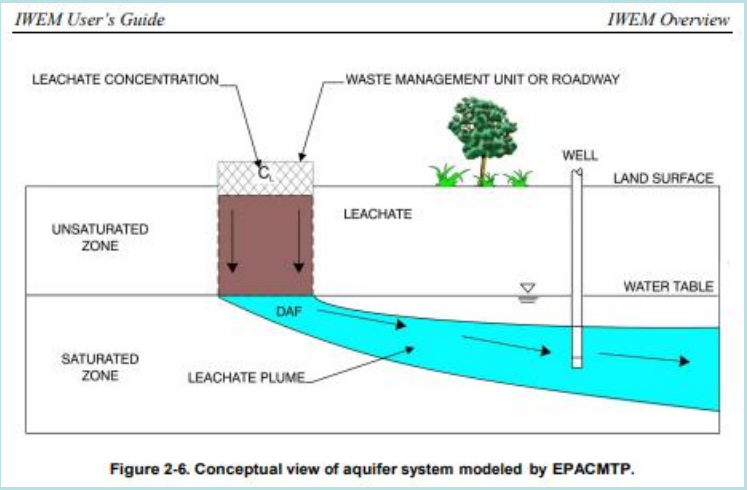
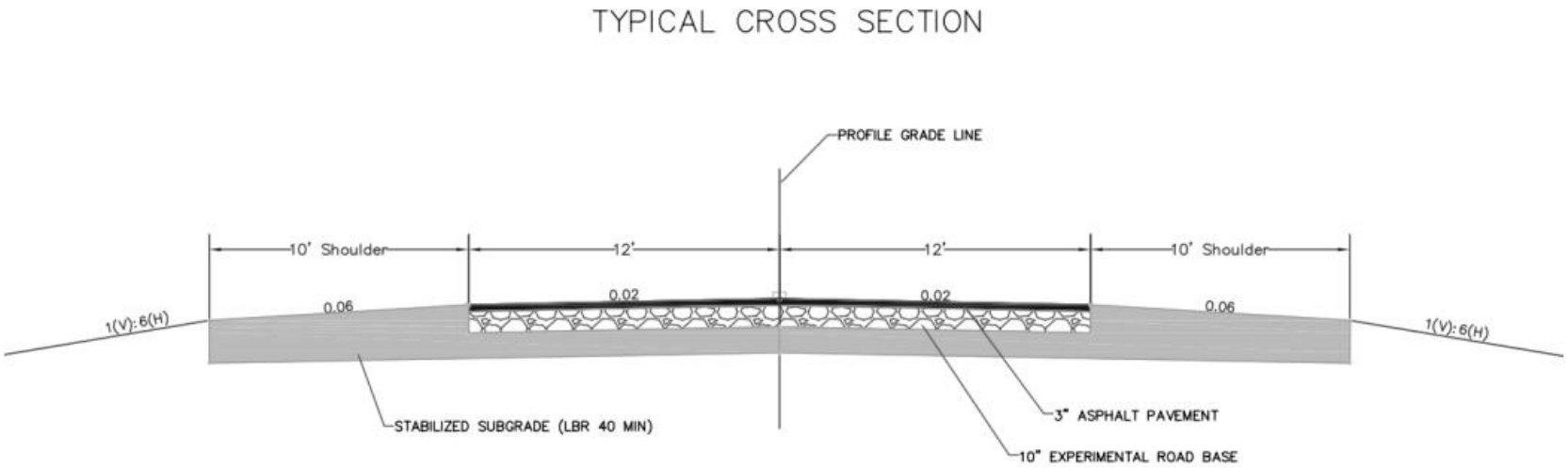


Figure 2-6. Conceptual view of aquifer system modeled by EPACMTP.

Preliminary Testing

- Leaching tests focused the risk assessment on the following constituents of interest:
  - Fluoride, Sulfate, Arsenic, Strontium, Molybdenum, Radium-226
- A dilution attenuation factor (DAF) of less than 10 would be required in all cases
- IWEM modeling results support that a properly designed and constructed road would achieve DAF greater than 10
- Goal of the pilot test is to verify these results

Proposed Road Design



- FDOT Road Design Manual – typical cross section
  - 24ft road width with 10ft shoulders
  - Fits with existing road
- Experimental road base constructed on existing road

10-inch base
3-inch asphalt pavement
2% cross-slope on road
6% slope for shoulders
1:6 side slope from shoulders
Minimum 3-foot-deep ditches on both sides

Pre-Construction Monitoring

- Soil
- Groundwater

Post Construction Monitoring: Environmental Performance

- Lysimeter monitoring
  - Volume of water
  - Constituent Concentrations
- Monitoring wells
  - Constituent concentration measurement
- Soil samples
  - Samples of soil taken at intervals for constituent measurement