# Carbon Capture and Mineralization Project

Public Draft

Initial Study

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Prepared for:
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Prepared by:
Brezack & Associates Planning

# Carbon Capture and Mineralization Project Description

## Introduction and Overview

San Francisco Bay Aggregates (SFBA) (Applicant), a wholly owned subsidiary of Blue Planet Ltd. (BP), is proposing to develop, own, and operate a carbon capture and mineralization pilot facility located in Pittsburg, California using proprietary BP technology (Process).

An outlet stream of gas from the gas-fired steam boiler process equipment onsite would provide the source of $CO_2$ that would be combined with locally sourced recycled/crushed concrete aggregate (RCA), to produce new “$CO_2$ sequestered” and “upcycled” rock products. Upcycling is the process of transforming by-products or waste materials into new materials or products of better quality or for better environmental value. It is anticipated the final product would exceed ASTM C33 Standard Specification for Concrete Aggregates that defines the quality of aggregate for use in concrete.

These upcycled rock products would be sold to Bay Area businesses, governments and consumers for use in a wide range of low carbon and high performance concrete applications.

This pilot project would be constructed and have the proof of concept operations completed in a total of fifteen months. Ultimately, the proposed project would remove carbon dioxide ($CO_2$) from a slipstream[1] of flue gas from Calpine’s Los Medanos Energy Center (LMEC); however, the transfer of the fluegas to the project area would likely not be ready for use by the pilot project. After completion of the pilot project, BP may decide to pursue a larger operation at the location of the pilot project in the City of Pittsburg or somehwhere else in the region depending on the results of the proposed pilot project. The larger operations would undergo a separate CEQA analysis as additional details beyond the pilot project have not been determined for the expanded operations.

## Project Purpose

The proposed project purpose includes:

- Verify that the proof of concept, to produce sustainable construction materials, is viable for investment in a larger facility.
- Use of 100 percent carbon free energy to power the proposed Project.
- Provide pre-marketing volumes of $CO_2$ sequestered and upcycled rock products for planned construction projects in the Bay Area

The broader objectives of the Project are to substantiate the potential of the following local environmental and economic priorities:

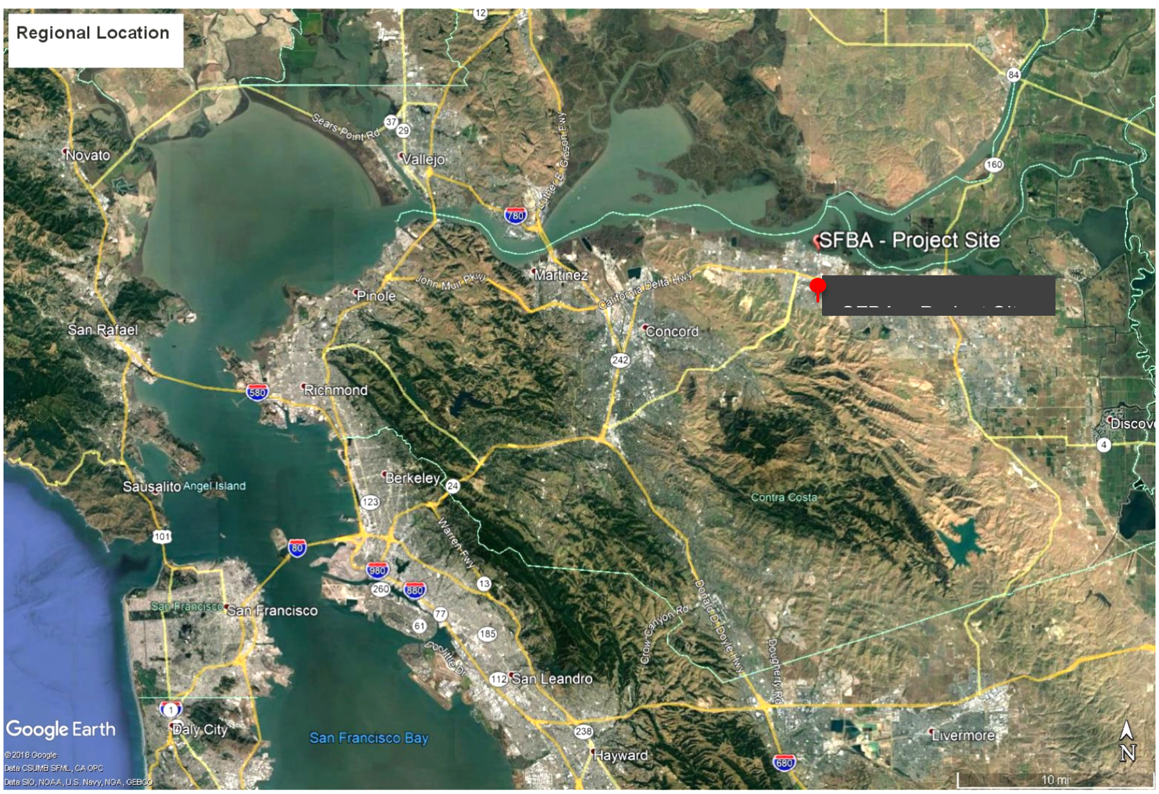
[1] Gas driven by a propellor.

- Reduction in greenhouse gas emissions, specifically $CO_2$, by the proposed Project for the capture and permanent sequestration of $CO_2$ from a slipstream of LMEC flue gas.
- Reduction in the environmental impact of quarrying virgin aggregate for construction projects, through remediation and upcycling of RCA from Bay Area construction projects into useable aggregate products.
- Finalize development of BP's technology for capturing and using $CO_2$ allowing the City of Pittsburg and the greater Bay Area to be a world leader in sustainable construction materials.

## Project Location

SFBA intends to construct and operate the proposed Project on a 2.5 acre parcel of land located at 895 East 3rd Street, Pittsburg, California 94565 in Contra Costa County. The Assessor's Parcel Number for the proposed project site is 073-020-019-3. As shown on Figure 1, the parcel is bounded to the north by New York Slough, Suisun Bay, part of the Sacramento-San Joaquin River Delta; to the east by land owned by USS-POSCO Industries (UPI) and by a PG&E substation; to the south by an easement that runs along East 3rd Street; and to the west by Koch Carbon Inc.

**Figure 1: Project Vicinity**



## Project Area Land Use and Development

The Pittsburg General Plan (City of Pittsburg, 2010) designates an approximately 689-acre area as the "Northeast River Planning Subarea." This Subarea is primarily characterized by established, large-scale heavy industrial operations. The proposed project is situated in the northwestern portion of the Subarea.

The Pittsburg General Plan indicates the proposed project area has a land use designation of *Industrial* and is zoned IG (General Industrial) District. The IG designation is the City's heavy industry zoning district that allows for a range of manufacturing, industrial processing, and general services.

## Project Setting

The proposed project site was previously host to a 20 megawatt cogeneration power plant, owned and operated by GWF Power Systems Company, Inc. (GWF). The facility was decommissioned in 2012 and the site has since been an empty lot used for truck parking. The proposed project site has a perimeter chain link fence. As shown on Figure 2, two buildings remain in place. Site remedial actions, prior to the construction of the GWF plant, resulted in contaminated soil excavation, consolidation and capping under building floors, asphalt pavements and landscaped areas that remain intact.[2] A Phase 1 environmental site assessment completed in August 2018 by Groundwater & Environmental Services, Inc. verified that the capping infrastructure remains in place sealing any contaminated soil from exposure to the environment and workers.

The property does not abut a public right of way; pedestrian access from the nearest public roadway does not exist. Access to the site is via a private road at the end of the public portion of 3rd Street.

The site provides the following infrastructure that will facilitate operations of the proposed project:

- Close proximity to flue gas input, a small slipstream of which will be diverted from LMEC, a neighbor to the project site at its southwest corner.
- Access to material transport, for raw materials and products, by way of East 3rd Street via standard trucking routes through the City of Pittsburg.
- An existing outfall pipe for discharge of thermal wastewater to the Sacramento-San Joaquin River Delta; previously in use while the GWF power plant was operating, the outfall was verified in December 2018 to be in good working condition.

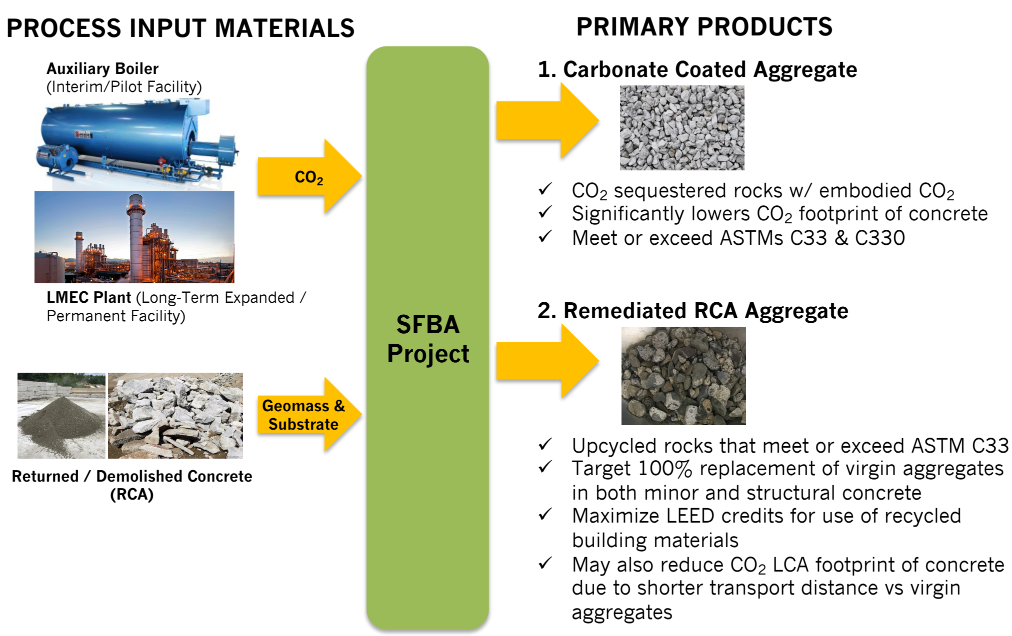
[2] Information located on Envirostor https://www.envirostor.dtsc.ca.gov/public/profile_report?global_id=07490047

Figure 2 View of Project Site looking west down 3rd Street.


## Project Description

The primary function of the proposed project is to take flue gas from LMEC and RCA feeds from local ready-mix concrete producers and recyclers to produce $CO_2$ sequestered and upcycled rocks for fresh concrete production as shown on Figure 3 the Process Diagram. On a temporary basis, the $CO_2$ outlet stream of gas from the gas-fired steam boiler process equipment would be used until the flue gas transfer operations from LMEC is online.

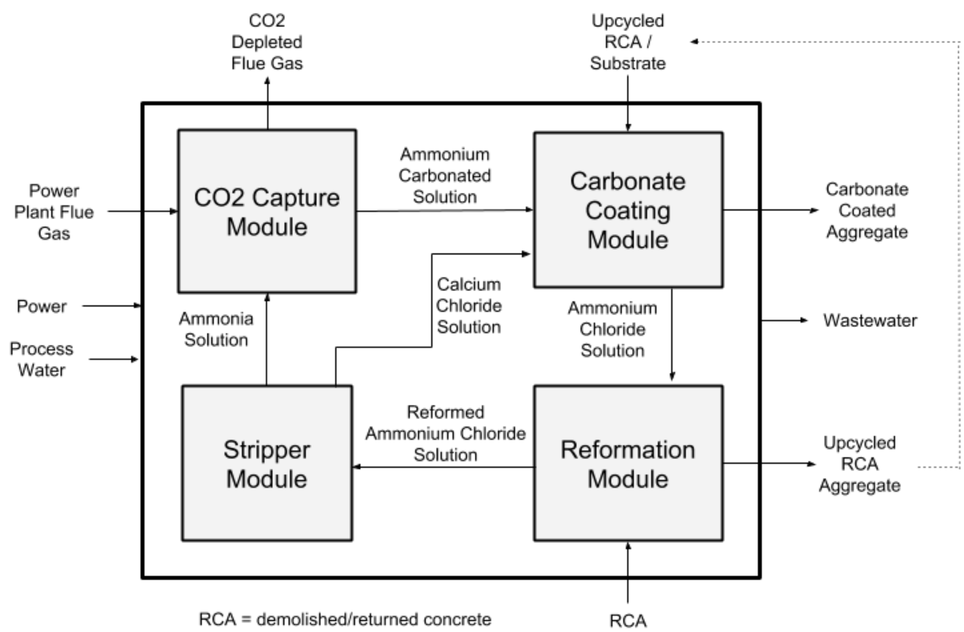
Figure 3 Process Diagram



The proposed project would link together four (4) component modules into a cycle for the overall Process. A module is a set of equipment from which an interim product is produced. Each module is made separately, and the completed modules are joined together to form the process of producing ingredients for fresh concrete production. The four modules are presented on Figure 4 are:

1. $CO_2$ Capture Module – removal of $CO_2$ from flue gas,
2. Carbonate Coating Module – calcium carbonate ($CaCO_3$) coating on the surface of the substrate rock,
3. Reformation Module – creation of upcycled rock for coating or placement in fresh concrete, and
4. Stripper Module– separation of aqueous ammonia and calcium chloride solutions for use in the $CO_2$ Capture and Carbonate Coating modules.

Figure 4 Modules of the Process




## Project Construction

The construction of the proposed project would not require any disturbance of soil beneath the existing site caps. The majority of the equipment would be skid mounted for mobilization to and from the proposed project site. No new foundation construction or new buildings would be constructed.

The duration of construction of the proposed project is estimated to be 3 to 4 months. It is estimated that a maximum of six (6) construction workers are required. Construction activity entails off-loading transported equipment and connecting the separate Modules together. Equipment used during construction would include:

- Forklift,
- Loader,
- Dump truck, and
- Transporter truck.

Staging areas and parking of worker vehicles would be contained to the 2.5 acre project site. A mobile office trailer would be installed for use during the operation of the proposed project. ADA parking and accessible portable restrooms would be set up during construction.

There are no planned changes to the existing site drainages. No new impervious surfaces are planned. Sediment barriers would be added to the existing drop inlets and would follow standard protocol:

1. Sandbags shall be laid tightly together.
2. Trapped sediment would be removed after each storm event and any required repairs made promptly thereafter.
3. Down slope elevations must be greater than the ponding height to prevent runoff from bypassing the inlet. A sandbag dike on the down slope may be necessary to prevent bypassing of the inlet as determined during operations.

## Proposed Operations

Up to three (3) people per shift would be required to operate the Facility. There would be one eight (8) hour shift per day. Operations would include occupancy of one of the existing buildings onsite. The proposed project would run the four (4) component modules that can operate continuously during the eight hour shift or in batch mode. This section describes the details of each module presented in Figure 4.

### $CO_2$ Capture Module

In this module, the LMEC flue gas and aqueous ammonia ($NH_3$) solution from the Stripping Module are blended in gas scrubbing equipment to remove $CO_2$ from the flue gas. The resulting aqueous ammonium carbonated solution (mixtures of aqueous ammonium bicarbonate ($NH_4HCO_3$) and of aqueous ammonium carbonate ($(NH_4)_2CO_3$) serves as a feed into the Carbonate Coating Module.

### Carbonate Coating Module

In this module, captured $CO_2$ from the flue gas is removed from the Process. Aqueous ammonium carbonated solution from the $CO_2$ Capture Module and aqueous calcium chloride ($CaCl_2$) solution from the Stripper Module are streamed into a rotating drum containing a substrate rock, sourced either as quarried rock or as upcycled rock from the Reformation Module. As the materials move through the length of the drum, a solid calcium carbonate ($CaCO_3$) coating forms on the surface of the substrate rock; any $CaCO_3$ formed, but not coated on the substrate produces precipitated $CaCO_3$. The resulting $CO_2$ sequestered products are washed with recycled water and are sent to market for placement in fresh concrete. Aqueous solution remaining from the coating drum contains ammonium chloride ($NH_4Cl$) salt and this solution is piped to the Reformation Module.

### Reformation Module

This module uses aqueous ammonium chloride solution from the Carbonate Coating Module to extract calcium ions ($Ca^{2+}$) and alkalinity ($O^{2-}$) from demolished/returned concrete feed. Mixing of these constituents in a drum yields remediated demolished/returned concrete rocks and reformed ammonium chloride solution. The upcycled rocks are either (i) used as substrate rock in the Carbonate Coating Module or (ii) washed with recycled water and sent to market for placement in fresh concrete. The reformed ammonium chloride solution, that now contains calcium chloride and free ammonia, flows to the Stripper Module for separation. Wastewater generated from the washing of material products would be minimized using recycling of water on-site.

## Stripper Module

Aqueous ammonia is separated or stripped out of the reformed ammonium chloride solution that comes from the Reformation Module. The pilot project may validate different methods of stripping; conventional stripping processes are driven by heat, for example, by using process steam produced from a separate boiler unit; other techniques such as vacuum distillation and air stripping may be used to separate the reformed ammonium chloride solution into aqueous ammonia and calcium chloride solutions. After separation, and to essentially complete the circular cycle of the overall Process, the former is condensed ahead of flowing to the $CO_2$ Capture Module, while the latter is flowed to the Carbonate Coating Module.

Figure 5 includes the detailed list of each piece of equipment included in each of the four modules.

Figure 5 Module Components

| | | |
|---|---|---|
| CO2 Capture Module | - Forced draft fan<br>- Gas-liquid contactors<br>- Contactors heat exchanger<br>- Contactor ammonia pump<br>- Ammonia scrubber<br>- Stack | |
| Carbonate Coating Module | - Substrate hopper<br>- Substrate vibratory feeder<br>- Aggregate dray conveyor<br>- Substrate belt conveyor<br>- CaCO3 thickener clarifier<br>- Thickener pump | - Vacuum dryer<br>- Wash water pump<br>- Product screen<br>- Product bins |
| Reformation Module | - RCA unloading hopper<br>- RCA feeder<br>- Reformation drum<br>- Separation conveyor<br>- Reformation pump<br>- RCA thickener clarifier | - Thickener pump<br>- Vacuum dryer<br>- Reformed solution tank<br>- Ammonium chloride tank |
| Stripper Module | - Stripper column<br>- Thermosyphon reboiler<br>- Ammonia condenser<br>- Calcium chloride storage tank<br>- Calcium chloride pump<br>- Stripper heat exchanger | - Ammonia surge tank<br>- Ammonia pump<br>- Gas-fired steam boiler |

## Process Input

Existing utility service and/or are service connections in place include gas, electric, potable and non-potable water hookups, as well as an existing outfall pipe that extends into New York Slough.

## Flue Gas

The ultimate process of obtaining flue gas involves a tie-in pipeline to one of LMEC's flue gas stacks and a pipeline to transport the flue gas through LMEC's site across East 3rd Street to the project site. The Applicant anticipates the timing of getting the slipstream of flue gas to the project site from LMEC may delay the project schedule. Therefore in the interim, the project would use the outlet stream of gas from the gas-fired steam boiler process equipment as an interim source of $CO_2$ input to the Facility. A blower would be used to move the outlet gas from the gas-fired steam boiler through an air-cooled heat exchanger that conditions the gas before it enters the process equipment for CO2 removal. This boiler supplied flue gas is similar to what would be delivered in a slipstream from LMEC. The onsite boiler gas would allow the project operations to be initiated while the slipstream of flue gas from LMEC is being connected to the facility.

## Water

The Process would use non-potable water for non-contact process cooling, washing of material products, and to replace evaporative losses of process water. SFBA plans to source non-potable canal water from UPI, via their water rights to the 47 mile Contra Costa Canal aqueduct that runs through central Contra Costa County. The canal is managed by the Contra Costa Water District (CCWD) and is delivered to UPI through a two-mile pipeline system owned and maintained by UPI. UPI also owns and operates a filter plant at its facility in Pittsburg, located to the south and to the east of the project site, through which it treats all canal water received from the CCWD. UPI controls an existing 6-inch pipe (previously constructed by GWF) running from its facility to the project site. It is estimated that a 1-inch meter would be needed to measure the quantities of water delivered to the project.

The Facility would use a closed process water loop for cooling; this process water does not come in direct contact with any other water in the Facility. It is anticipated that during operations the Facility would use less than 30 gallons per minute (gpm) of water to wash the products, with less than 10% of this volume being used as mist for dust control. In addition, the estimated quantity of make-up water during operations is less than 50 gpm and is anticipated to come from the UPI non-potable water and from City water.

## Gas & Electric

Pacific Gas & Electric (PG&E) has gas and electric hookups at the site. The last "new construction" was in 2013 (for electric) and the site was last inspected by PG&E in 2014. The main electric connection is 400A/480V/3-phase with meter (currently in service), and the site does have additional single phase meters. It is anticipated that the Process would be powered with 100% renewable electricity available from the grid through the City of Pittsburg's participation in Contra Costa County's CCE program provided by MCE Contra Costa.

The project would use a gas steam boiler to help drive the Stripper Module component of the Process. The existing gas infrastructure to the site consists of a 230 foot, 3-inch steel pipeline from the main with delivery of 15/80 PSI; it was cut and capped in 2012 and would need a meter installed to start service.

## Chemical Storage and Use/Safety Procedures

All chemicals delivered to the site in bulk quantities would be stored in fully contained bulk storage tanks and/or storage vessels having a capacity of less than 260 gallons (or as otherwise restrained by vapor pressure requirements, types of materials stored, etc.). All chemical storage, handling, and feed facilities would be designed, constructed, and maintained in compliance with all applicable governmental codes and regulations. California law requires the Project Applicant, as the operator of the facility, to submit a Hazardous Material Business Plan (HMBP), that describes in detail the type and volume of chemicals to be used at the facility, to the Contra Costa Health Services - Hazardous Materials Programs (CCHSHMP). The CCHSHMP is the Certified Unified Program Agency (CUPA) for Contra Costa County.

The HMBP must include a reporting and monitoring process for any spills that may occur. It also must include requirements for safety equipment, automatic shut-off valves, and other safety procedures that may be required, depending on the types and volumes of chemicals stored and used. The potential for facility upset conditions and accidents would be minimized with design of secondary containments sized to confine the entire contents of stored chemicals, proper training of operators, and having an emergency response plan in place that outlines procedures to quickly react in the event of an accident or spill. Chemicals and other inputs used in the Process are listed in Table 1. All chemical storage would include secondary containment.

Table 1 Chemicals and Quantities Stored Onsite

| **Chemical** | **Common Name, Physical State** | **Approximate Storage Volume** | **Location of Chemical Addition** |
|---|---|---|---|
| $NH_4Cl$ | Ammonium chloride, solid | One (1) pallet or roughly 2,200 lb; 40 x 50 lb bags | Reformer Module |
| $NH_3$ | Ammonia, 0.5 to 19 wt% aqueous solution | One (1) tank of less than 260 gal; less than 2,100 lb | $CO_2$ Capture Module |
| HCl | Hydrochloric acid, 30% aqueous solution | One (1) tank of less than 260 gal; less than 2,500 lb | $CO_2$ Capture Module, Carbonate Coating Module |
| $CaCl_2$ | Calcium chloride, solid | One (1) pallet or roughly 2,200 lb; 40 x 50 lb bags | Carbonate Coating Module |
| n/a | Waste concrete aggregate, solid | Two (2) piles or roughly 25 cubic yards; 17 ft. w x 17 ft. l x 5 ft. h piles | Reformer Module |

A Site-Specific Safety Plan to address safety issues specific to the facility would be developed and be consistent with the existing Safety Program and Policies in the SFBA Safety Plan. The plans would be developed as part of the Site-Specific Safety Plan for the project and include:

- Scope of Project,
- Health & Safety Responsibilities,
- General Safety Procedures,
- Jobsite Safety Procedures, and
- Safety Program & Policy Limitations.

The Project would include the development of an industrial fire safety plan consistent with applicable standards and fire codes. Fire systems that would be in place include fire extinguishers, fire sprinkler and smoke and fire alarm systems as required, as well as exit signs and emergency lighting. Any additional access lighting required for personnel and for security would consist of permanently mounted fixtures secured to structures, equipment, walls, and poles as required, and would be designed to provide nighttime lighting levels consistent with applicable standards.

## Process Output

Figure 3 illustrates the primary function of the Project operations to use flue gas and RCA feeds to produce $CO_2$ sequestered and upcycled rocks for incorporation into fresh concrete. Several other byproducts, produced during the Process, are discussed below.

### Treated Flue Gas

The treated flue gas, depleted of $CO_2$ during the Carbon Capture Module, would be scrubbed by a secondary set of gas scrubbing equipment. This scrubbing equipment would be located just upstream of the stack to recover any fugitive ammonia vapor. The remains of the treated flue gas would then be exhausted through the stack into atmosphere.

### Wastewater

The estimated maximum thermal wastewater generated during operations is 50 gpm that would be discharged through the existing outfall at the site. Wastewater from washing and rinsing of product material, anticipated to be less than 30 gpm, would be collected and sent to the City sewer system in accordance with the City of Pittsburg's Clean Water Program.

Water used for cooling in the Process would be discharged through the outfall pipe that exits at the northeast corner of the project site into New York Slough for 12 months from the time of the initial operations of the pilot project. The average discharge would be 24,000 gallons per day and the maximum discharge would be 72,000 gallons per day. The discharge to the Slough would not come into direct contact with the facility processes. Any thermal wastewater discharge to the River Delta would adhere to San Francisco Bay Regional Water Quality Control Board's Thermal Plan that prohibits thermal waste discharges with a maximum temperature greater than 4 °F above ambient temperature of the receiving water. Other wastewater generated from the washing of material products would be minimized, utilizing recycling systems on-site and storing collected wastewater in tanks for treatment prior to disposal.

Wastewater discharges would be monitored according to the relevant limit values for specific parameters outlined in compliance documents received during the permitting process. The parameters are anticipated to include temperature, hardness, total chlorides, conductivity and metals. Monitoring of the wastewater would be done at least one (1) time during the planned 6-9 month operational duration, likely just after commissioning of the Facility and, if deemed necessary, after approximately 500 hours of the Facility being in operation.

Monitoring would consist of internationally accepted standardized sampling, analysis, and quality assurance methods (e.g., ISO standards). Analyses would use the State Water Board's Thermal Plan (for thermal wastewater discharge) and the City's urban wastewater treatment (for discharge to sewer) for exceedance thresholds.

### Solid Waste

The trash enclosure is sized to accommodate a dumpster with at least ten (10) cubic yards of capacity. The municipal waste service provided by Mt. Diablo Resource Recovery would empty this dumpster as needed during construction. All products from the Facility are anticipated to be used as construction materials in building products; any other solid waste from operations would be contained in the dumpster in the trash enclosure and would be emptied as scheduled with Mt Diablo Resource Recovery.

### Gas Emmissions

The use of aqueous ammonia solution in the process results in the potential for emissions from two sources. The first is from unreacted ammonia in $CO_2$ depleted flue gas in the $CO_2$ Capture Module and the second is from fugitive ammonia vapors from the Process. The project would use a combination of the following techniques to manage odorous ammonia emissions:

1. Installation of gas seals on equipment associated with ammonium ions or free aqueous ammonia.
2. Carbonate Coating Module would operate at slight negative pressure.
3. Any process modules that use ammonia would have its equipment contained in an enclosure with extraction/emission to a single point to manage odor.
4. Scrubbing equipment upstream of the stack to recover any fugitive ammonia vapor before release of treated flue gas through the stack.
5. Gas tight piping would be used to interconnect the equipment that requires gas flow through.

## Materials Storage and Transport

The project would receive inbound RCA as a raw material input and would produce carbonate coated rocks and upcycled RCA as the primary products outbound to the concrete market clients. Supplementary cementitious material (SCM) also heads outbound to market.

Input and product materials would be stored outdoors in managed piles, two for each. Each pile would be surrounded by berms to prevent precipitation runoff from discharging off site. Front-loaders would move material to and from the component modules or the truck loading and unloading areas. The storage and loading operations would use water-to manage dust. The site would allow space for up to one week's worth input material and product material. However, in stable operation, the input material and product material would arrive and leave on a 1:1 rotation and require minimal storage. Potential locations for material storage onsite run along the north perimeter of the property and include both its northeast and its northwest corners.

The projected daily volume of inbound and outbound material movement at the project site is provided in Table 2. The Applicant is planning for inbound trucks to travel east along East 3rd Street and enter the project site at the east gate, while outbound trucks leave the site at the west gate and travel west along East 3rd Street. The Applicant anticipates inbound and outbound trucks to access East 3rd Street from Harbor Street via standard trucking routes through the City of Pittsburg. To minimize the cost and the impact to the City of Pittsburg from transportation of material, the hauling plan is for trucks to complete round trips to and from the project site with "full" loads; assuming 20 US ton (10 $yd^3$) per truck. As little as 15% of the total truck trips are estimated to be empty, total throughput of material is 2.6 $yd^3$/hr. During an 8-hour day of operation that equates to roughly three (3) round trip trucks per day for a total of 6 vehicle round trips per day in combination with worker's travel to and from the project site.

Table 2 Projected Daily Volume of Material Movement.

| Material Type[3] | Throughput Capacity | Truck[4] (No./day) |
|---|---|---|
| $CO_2$ | 221 lb/hr | n/a |
| Inbound RCA | 2.5 $yd^3$/hr | 2.3 |
| Coated Product | 1.3 $yd^3$/hr | 1.2 |
| Upcycled RCA | 1.1 $yd^3$/hr | 1.0 |
| SCM | 0.1 $yd^3$/hr | 0.1 |
| **TOTAL Throughput** | **2.6 $yd^3$/hr** | **3.0** |

[3] Coated Product, Upcycled RCA and SCM are outbound products produced from Inbound RCA input material.

[4] Assumes 8 hours per day of operation, 20 US ton (10 $yd^3$) per truck and 15% of truck trips are empty; no./day rounded up to nearest 0.1; TOTAL assumes Coated Product, Upcycled RCA and SCM.

Figure 6 is an aerial view of project site with proposed truck route inside the fence of the project site denoted in green.

Figure 6 Onsite Truck Route


## Noise

The materials handling process equipment would generate some noise, it is not anticipated that the noise level would exceed 85 dBA (adjusted decibels) during an eight (8) hour exposure time.