## Simi Valley SSFL - Roadway Segment Volumes

**Initial Analysis of Daily Conditions- Existing 2015 + Project**

**96 Trucks and 250 Employees**

| Seg ID | Segment | From | To | 2012 Traffic Count | Existing 2015 Volume |
|---|---|---|---|---|---|
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | 14,547 | 14,983 |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | 14,510 | 14,945 |
| C | Tapo Canyon Road | Cochran Street | SR-118 | 29,994 | 30,894 |

*Note: Per-lane capacity based on extrapolations of Highway Capacity Manual methodology (10,000 daily vehicles, approx. 500 to 600 peak-hour vehicles)*

## SSFL Feasibility Analysis - Roadway Segment Volumes

**Initial Analysis of Daily Conditions- Existing 2015 + Project**

**96 Trucks**

| Seg ID | Segment | From | To | Existing 2015 Daily Volumes | | | | | Existing 2015 + Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | # of Lanes | Capacity | Volume | V/C | LOS | Project Only | Volume | V/C | LOS |
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | 4 | 40,000 | 14,983 | 0.375 | A | 480 | 15,463 | 0.387 | A |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | 4 | 40,000 | 14,945 | 0.374 | A | 480 | 15,425 | 0.386 | A |
| C | Tapo Canyon Road | Cochran Street | SR-118 | 4 | 40,000 | 30,894 | 0.772 | C | 480 | 31,374 | 0.784 | C |

*Note: Per-lane capacity based on extrapolations of Highway Capacity Manual methodology (10,000 daily vehicles, approx. 500 to 600 peak-hour vehicles)*

## SSFL Feasibility Analysis - Roadway Segment Volumes

**Initial Analysis of Daily Conditions- Future 2034 + Project**

**96 Trucks**

| Seg ID | Segment | From | To | Existing 2015 Daily Volumes | | | | | Future 2038 without Project | | | | Future 2038 with Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | # of Lanes | Capacity | Volume | V/C | LOS | Ambient Growth | Volume | V/C | LOS | Project Only | Volume | V/C | LOS |
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | 4 | 40,000 | 14,983 | 0.375 | A | 23% | 18,430 | 0.461 | A | 480 | 18,910 | 0.473 | A |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | 4 | 40,000 | 14,945 | 0.374 | A | 23% | 18,383 | 0.460 | A | 480 | 18,863 | 0.472 | A |
| C | Tapo Canyon Road | Cochran Street | SR-118 | 4 | 40,000 | 30,894 | 0.772 | C | 23% | 37,999 | 0.950 | **E** | 480 | 38,479 | 0.962 | **E** |

*Note: Per-lane capacity based on extrapolations of Highway Capacity Manual methodology (10,000 daily vehicles, approx. 500 to 600 peak-hour vehicles)*

## SSFL Feasibility Analysis - Roadway Segment Volumes

**Initial Analysis of Peak Conditions- Existing 2015 + Project**

**96 Trucks**

| Seg ID | Segment | From | To | Peak Period | Existing 2015 Peak Volumes | | | | | Existing 2015 + Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | # of Lanes * | Capacity | Volumes | V/C | LOS | Project Only | Volumes | V/C | LOS |
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | AM | 4 | 2,500 | 1,498 | 0.599 | A | 60 | 1,558 | 0.623 | B |
| | | | | PM | | | 1,498 | 0.599 | A | 60 | 1,558 | 0.623 | B |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | AM | 4 | 2,500 | 1,495 | 0.598 | A | 60 | 1,555 | 0.622 | B |
| | | | | PM | | | 1,495 | 0.598 | A | 60 | 1,555 | 0.622 | B |
| C | Tapo Canyon Road | Cochran Street | SR-118 | AM | 4 | 2,500 | 3,089 | 1.236 | **F** | 60 | 3,149 | 1.260 | **F** |
| | | | | PM | | | 3,089 | 1.236 | **F** | 60 | 3,149 | 1.260 | **F** |

** Based on most constricted segment of overall roadway.*

*** Peak base volumes based on typical 10 percent volume ratio of peak to daily.*

*Note: Capacity calculations based on interpretations of Highway Capacity Manual methodology.*

## SSFL Feasibility Analysis - Roadway Segment Volumes

**Initial Analysis of Peak Conditions- Future 2034 + Project**

**96 Trucks**

| Seg ID | Segment | From | To | Peak Period | Existing 2015 Peak Volumes | | | | | Future 2038 without Project | | | | Future 2038 with Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | # of Lanes * | Capacity | Volumes | V/C | LOS | Ambient Growth | Volumes | V/C | LOS | Project Only | Volumes | V/C | LOS |
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | AM | 4 | 2,500 | 1,498 | 0.599 | A | 23% | 1,843 | 0.737 | C | 60 | 1,903 | 0.761 | C |
| | | | | PM | | | 1,498 | 0.599 | A | 23% | 1,843 | 0.737 | C | 60 | 1,903 | 0.761 | C |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | AM | 4 | 2,500 | 1,495 | 0.598 | A | 23% | 1,838 | 0.735 | C | 60 | 1,898 | 0.759 | C |
| | | | | PM | | | 1,495 | 0.598 | A | 23% | 1,838 | 0.735 | C | 60 | 1,898 | 0.759 | C |
| C | Tapo Canyon Road | Cochran Street | SR-118 | AM | 4 | 2,500 | 3,089 | 1.236 | **F** | 23% | 3,800 | 1.520 | **F** | 60 | 3,860 | 1.544 | **F** |
| | | | | PM | | | 3,089 | 1.236 | **F** | 23% | 3,800 | 1.520 | **F** | 60 | 3,860 | 1.544 | **F** |

** Based on most constricted segment of overall roadway.*

*** Peak base volumes based on typical 10 percent volume ratio of peak to daily.*

*Note: Capacity calculations based on interpretations of Highway Capacity Manual methodology.*

## SSFL Feasibility Analysis - Roadway Segment Volumes

**Initial Analysis of Daily Conditions- Future 2034 + Project**

**48 Trucks** (half to Tapo Canyon, half to Topanga Canyon etc.)

| Seg ID | Segment | From | To | Existing 2015 Daily Volumes | | | | | Future 2034 without Project | | | | Future 2034 with Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | # of Lanes | Capacity | Volume | V/C | LOS | Ambient Growth | Volume | V/C | LOS | Project Only | Volume | V/C | LOS |
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | 4 | 40,000 | 14,983 | 0.375 | A | 19% | 17,830 | 0.446 | A | 120 | 17,950 | 0.449 | A |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | 4 | 40,000 | 14,945 | 0.374 | A | 19% | 17,785 | 0.445 | A | 120 | 17,905 | 0.448 | A |
| C | Tapo Canyon Road | Cochran Street | SR-118 | 4 | 40,000 | 30,894 | 0.772 | C | 19% | 36,764 | 0.919 | **E** | 120 | 36,884 | 0.922 | **E** |

*Note: Per-lane capacity based on extrapolations of Highway Capacity Manual methodology (10,000 daily vehicles, approx. 500 to 600 peak-hour vehicles)*

## SSFL Feasibility Analysis - Roadway Segment Volumes

**Initial Analysis of Peak Conditions- Future 2034 + Project**

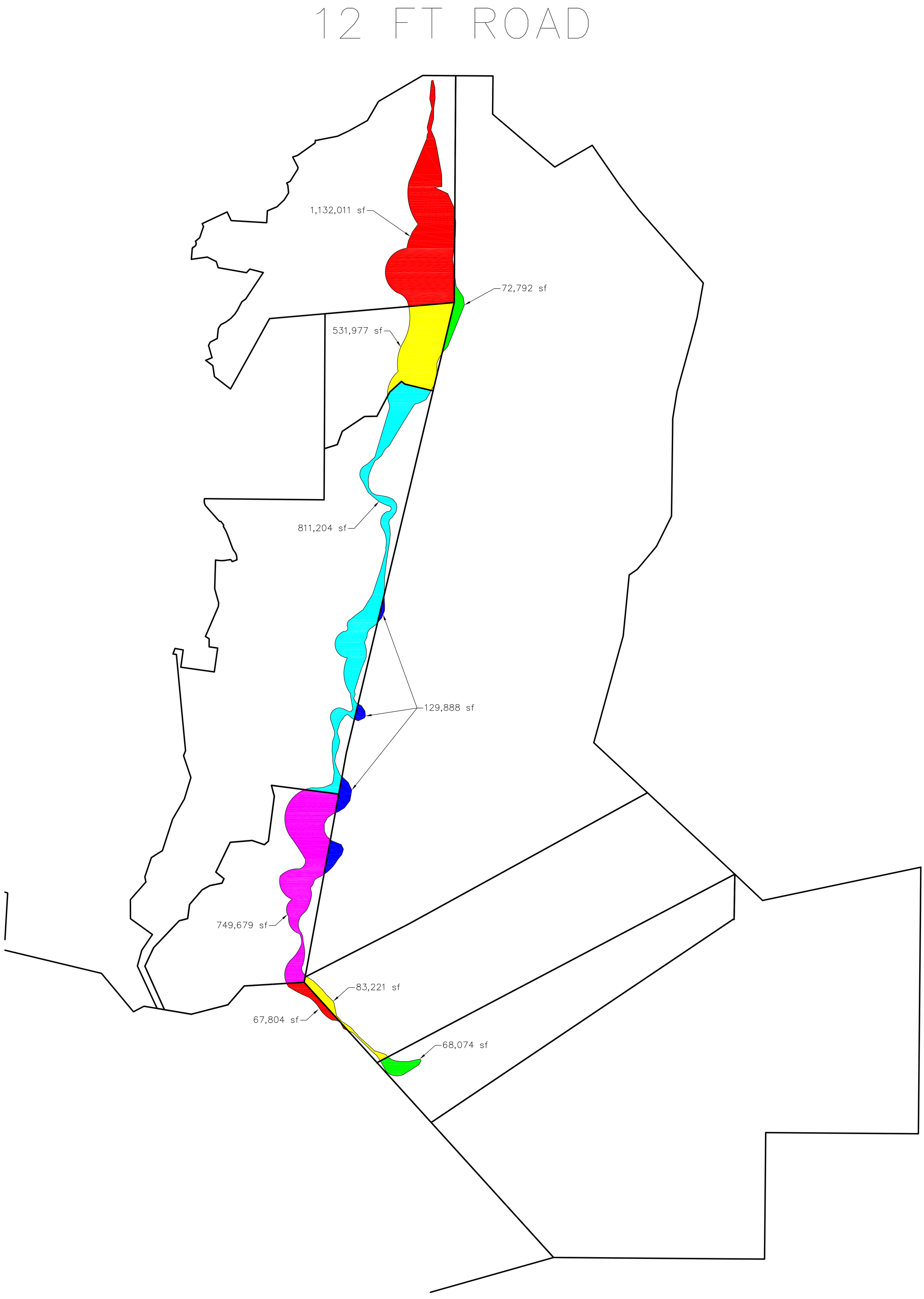
**48 Trucks**

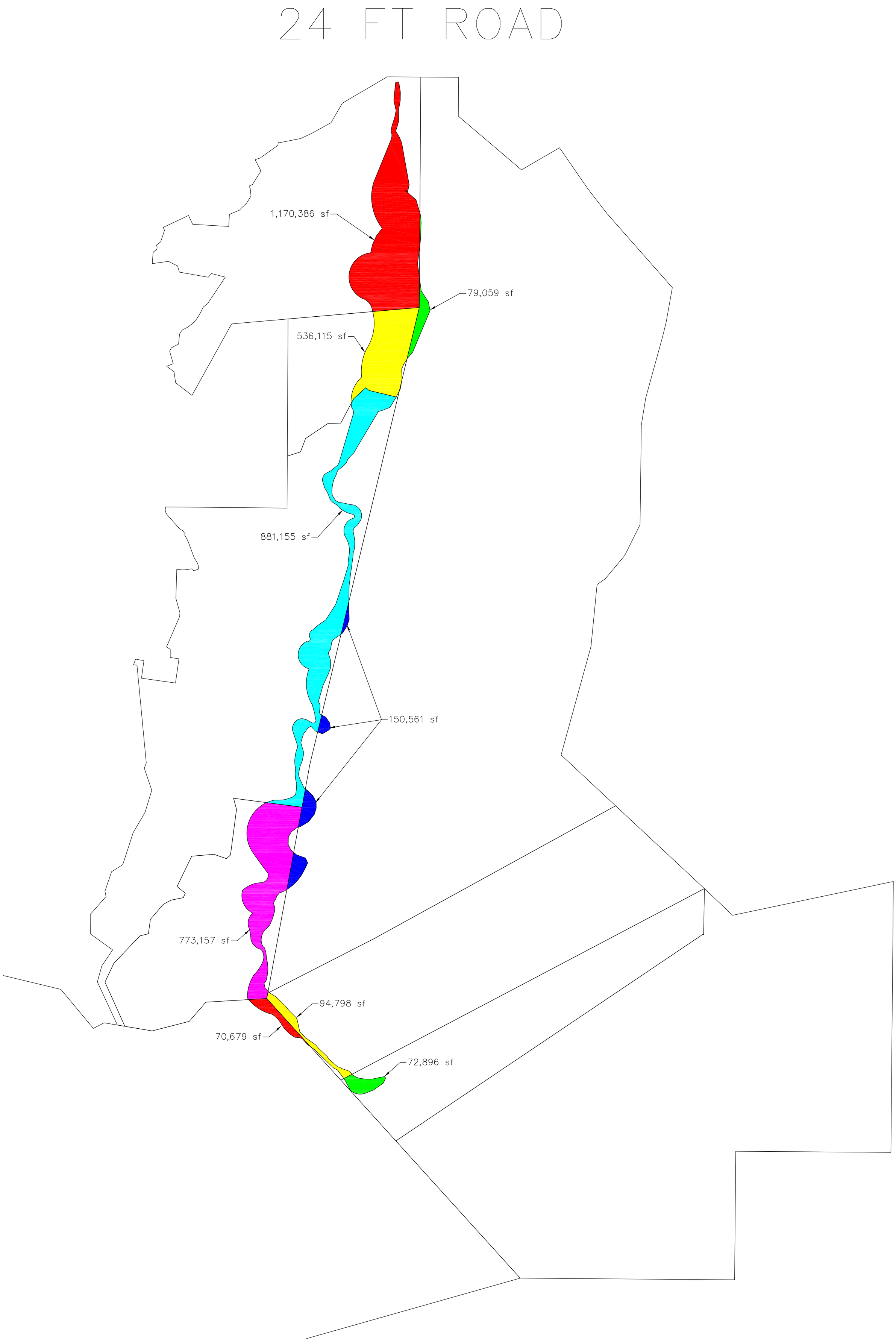
| Seg ID | Segment | From | To | Peak Period | Existing 2015 Peak Volumes | | | | | Future 2034 without Project | | | | Future 2034 with Project | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | # of Lanes * | Capacity | Volumes | V/C | LOS | Ambient Growth | Volumes | V/C | LOS | Project Only | Volumes | V/C | LOS |
| A | Tapo Canyon Road | Royal Avenue | Los Angeles Avenue | AM | 4 | 2,500 | 1,498 | 0.599 | A | 19% | 1,783 | 0.713 | C | 15 | 1,798 | 0.719 | C |
| | | | | PM | | | 1,498 | 0.599 | A | 19% | 1,783 | 0.713 | C | 15 | 1,798 | 0.719 | C |
| B | Tapo Canyon Road | Los Angeles Avenue | Cochran Street | AM | 4 | 2,500 | 1,495 | 0.598 | A | 19% | 1,778 | 0.711 | C | 15 | 1,793 | 0.717 | C |
| | | | | PM | | | 1,495 | 0.598 | A | 19% | 1,778 | 0.711 | C | 15 | 1,793 | 0.717 | C |
| C | Tapo Canyon Road | Cochran Street | SR-118 | AM | 4 | 2,500 | 3,089 | 1.236 | **F** | 19% | 3,676 | 1.470 | **F** | 15 | 3,691 | 1.476 | **F** |
| | | | | PM | | | 3,089 | 1.236 | **F** | 19% | 3,676 | 1.470 | **F** | 15 | 3,691 | 1.476 | **F** |

** Based on most constricted segment of overall roadway.*

*** Peak base volumes based on typical 10 percent volume ratio of peak to daily.*

*Note: Capacity calculations based on interpretations of Highway Capacity Manual methodology.*


12 FT ROAD
1,132,011 sf
72,792 sf
531,977 sf
811,204 sf
129,888 sf
749,679 sf
83,221 sf
67,804 sf
68,074 sf


24 FT ROAD
1,170,386 sf
79,059 sf
536,115 sf
881,155 sf
150,561 sf
773,157 sf
94,798 sf
70,679 sf
72,896 sf

**Edison Road Construction Costs**

Assume conservative two-lane road to provide high-end estimate
assumed length of 12,000 linear feet

| | | |
|---|---|---|
| Miles | | 2.27 |
| Price per mile | $ | 5,708,853 |

| | | Per Unit | Units | | Total | | |
|---|---|---|---|---|---|---|---|
| Grading and Excavation | $ | 130 | cubic yard | $ | 5,777,778 | | |
| Drainage | | - | lump sum | $ | 30,000 | | |
| Asphalt Pavement | $ | 120 | ton | $ | 1,152,000 | | |
| Retaining Walls | $ | 50 | sq.ft. | $ | - | | |
| Overhead & Misc | | - | lump sum | $ | 250,000 | | |
| Topo Survey | | - | lump sum | $ | 40,000 | | |
| Engineering | | - | lump sum | $ | 300,000 | | |
| Construction Engineering | | - | lump sum | $ | 250,000 | | |
| Project Adminstration | | - | lump sum | $ | 100,000 | | |
| | | | | | | With 50% High-End Escalation | |
| **TOTAL CONSTRUCTION** | | | | **$** | **7,899,778** | **$** | **11,849,667** |
| 10-Year Maintenance | | - | lump sum | $ | 350,000 | | |
| **TOTAL WITH MAINTENANCE** | | | | **$** | **8,249,778** | **$** | **12,374,667** |
| Removal and Remediation | | - | lump sum | $ | 400,000 | | |
| **TOTAL LIFESPAN COST** | | | | **$** | **8,649,778** | **$** | **12,974,667** |

Rough Cost for Truck Site 1
Assumes 7 acres grade and pave for truck loading operations

CONSTRUCTION

| Item | Description | Qty | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|---|
| 1 | Mobilization | 1 | LS | $ 50,000 | $ 50,000 |
| 2 | Construction Survey and Monumentation | 1 | LS | $ 25,000 | $ 25,000 |
| 3 | Stormwater Protection Plan | 1 | LS | $ 20,000 | $ 20,000 |
| 4 | Clearing and Grubbing | 1 | LS | $ 25,000 | $ 25,000 |
| 5 | Site Grading | 16940 | CY | $ 25 | $ 423,500 |
| 6 | Perimeter Fence | 2500 | LF | $ 20 | $ 50,000 |
| 7 | Security Facilities/Site Office | 1 | LS | $ 800,000 | $ 800,000 |
| 8 | Containment Facilities | 1 | LS | $ 200,000 | $ 200,000 |
| 9 | Storm Water Collection, Treatment, Disposal Facilities | 1 | LS | $ 200,000 | $ 200,000 |
| 10 | Aggregate Base | 17151.75 | TONS | $ 35 | $ 600,311 |
| 11 | Asphalt Pavement | 7546.77 | TONS | $ 75 | $ 566,008 |
| 12 | Curb and Gutter | 3000 | LF | $ 35 | $ 105,000 |
| 13 | Striping, signing, markings | 1 | LS | $ 25,000 | $ 25,000 |
| 14 | Drive Access | 1 | LS | $ 50,000 | $ 50,000 |
| 15 | Gates | 1 | LS | $ 30,000 | $ 30,000 |
| 16 | Lighting | 1 | LS | $ 250,000 | $ 250,000 |
| 17 | Truck Wheel Wash | 1 | LS | $ 10,000 | $ 10,000 |
| 18 | Biological Protection During Construction | 1 | LS | $ 200,000 | $ 200,000 |
| 19 | Site Abandonment and Restoration | 1 | LS | $ 500,000 | $ 500,000 |
| | | | | CONSTRUCTION TOTAL | $ 4,129,819 |

SOFT COSTS

| | | | | | |
|---|---|---|---|---|---|
| | Engineering | 1 | LS | $ 200,000 | $ 200,000 |
| | Environmental | 1 | LS | $ 250,000 | $ 250,000 |
| | Construction Management and Inspection | 1 | LS | $ 250,000 | $ 250,000 |
| | Testing | 1 | LS | $ 50,000 | $ 50,000 |
| | Offsite Mitigation Improvements | 1 | LS | $ 1,000,000 | $ 1,000,000 |
| | | | | SOFT COSTS TOTAL | $ 1,750,000 |

$ 5,879,819
-30/+50 escalation
high end factor
$ 8,819,729

RailPros, Inc.

# Santa Susana Field Lab Rail Logistics Feasibility Study

RAILPROS

8-26-2015

## Executive Summary

RailPros, Inc. was requested to develop this study to evaluate the feasibility of two locations ("Site 1" and "Site 2B") near Kuehner Drive for use as sites where soils excavated from the Santa Susana Field Lab (SSFL) could be loaded onto railroad cars for shipment to the final disposal location.

This study was based on two options for moving soils from SSFL to the railcar loading site: via a material conveyor system (various conveyors are being studied in both ground and aerial configurations) extending between SSFL and the railcar loading site or in individual 20' long bulk material containers mounted on truck chassis, in the same manner intermodal containers are handled at ports.

The two methods of moving soil from SSFL require different railcar loading site configurations, and different types of railcars. Moving soil from SSFL on a conveyor would require use of gondola railcars which would be loaded with soil at the railcar loading site Moving the soil from SSFL to the railcar loading site in containers mounted on individual trucks would require specialized railcars upon which the containers could be mounted, and special equipment to lift the containers off the truck chassis onto the railcars.

This study has determined that both Site 1 and Site 2B are feasible for use as railcar loading sites from a technical perspective and from an operational perspective. Site 2B is preferable, and offers more flexibility and would likely offer reduced operational costs.

Note that final approval for either site as a rail loading site and for transport of the soil is contingent upon the affected railroads, Union Pacific and the Southern California Regional Rail Authority. The cost-effectiveness of rail is contingent upon the commercial terms of the rail transportation, although for unit train service, it is possible that rail transportation to the disposal site could be as much as an order of magnitude less expensive than comparable truck transportation. Based upon this feasibility study, we believe that preliminary discussions with the railroads can commence.

Capital costs for the two sites range from $31.4 million to $60.2 million, including contingencies, though these costs could be reduced significantly when a decision is made as to whether containers or conveyors would be used to move soil.

# I. Introduction

The Santa Susana Field Lab (SSFL) project is considering the movement of contaminated soils by rail to a disposal location. This document describes the primary considerations for moving contaminated soil by rail, identifies mode choice considerations for moving the soil from SSFL to the rail load-out facility, and presents an investigation of two site options for rail load-out facilities north of the SSFL site.

As part of this evaluation, two rail load-out sites have been considered, Site 1 and Site 2B. Both are deemed to be feasible for a truck-to-rail or conveyor-to-rail loading location. The general locations and numeric designation (i.e., Site 1 and Site 2B) for these two sites were determined in prior studies for SSFL by KOA and CH2M Hill. Both locations are adjacent to the Santa Susana Siding on the Southern California Regional Rail Authority's Ventura Subdivision. The site locations span the range from approximately railroad milepost 440.3 to milepost 441.0. Other rail sites identified in the previous reports were evaluated at a high level, but considered less desirable from an operational and site layout perspective, or completely infeasible altogether.

Site 1 is roughly rectangular in shape and is bounded on the west by Kuehner Drive, on the north by Smith Road, on the south by the railroad tracks, and on the east by an existing, privately owned warehouse property.

An overall view of Site 1 is shown below. The approximate footprint of site 1 is shown in red.

Site 2B is a long, linear site on the north side of the railroad tracks, varying in width from approximately 40' wide to as much as 150' wide, extending from the Kuehner Drive overpass to approximately the entrance to Tunnel 26. It is bounded on the north by the private warehouse property, a movie set location, and Corriganville Park. On the south it is bounded by the railroad tracks.

An overall view of Site 2B is shown below. The approximate footprint of site 2B is shown in red.

## II. Key Assumptions

The volume of material to be handled and the rate at which it would be generated is a key consideration. For this concept study, it has been assumed that a total volume of approximately 2 million bank cubic yards (CY) of contaminated soil would need to be shipped by rail. This material would arrive at the railcar loading site at the rate of 1000 CY to 2000 CY per day. An assumed material density of 1.85 tons per bank cubic yard (ie, density of the soil in-place, prior to excavation) has been used for railcar loading. In the case of soils, railcars will likely reach their maximum weight capacity before they reach the maximum volumetric capacity, so the additional volume of the loose material (as opposed to the bank condition) is not expected to affect railcar capacity. Once clean-up at SSFL is complete, the railcar loading infrastructure would be removed and the site restored to its original condition.

It is also assumed that railcars will move in "unit trains," which are generally comprised of 60 or more railcars which move together from origin to destination and return with no intermediate switching. Thus unit trains offer a simpler operating scheme and more reliable travel times compared to shipping individual railcars; individual railcars would have to be incorporated into other trains and thus subject to switching at intermediate points.

Because of the efficiencies associated with unit trains, they offer very significant shipping cost savings compared to shipping by truck. In general terms, shipping by unit train can be as much as an order of magnitude (i.e., a factor of 5 to 10 times) less expensive than shipping by truck.

## III. Material Logistics and Railcar Selection

The SSFL project has determined that, if rail is part of the final logistics solution, contaminated soils would be moved from the SSFL site to the rail facility either by conveyor or by truck. Note that the final disposal location and selection of railcar type – either gondola car or Articulated Bulk Container (ABC) car – has not been made at this time.

**Truck and Container Option**
If trucks are selected to move soil from SSFL to the rail load-out site, soils would likely be loaded directly into open-top shipping containers mounted on truck chassis at the SSFL site. Tarps or covers would then be applied to the containers to eliminate dust escaping from the containers. Trucks would then transport the containers the relatively short distance from SSFL to the rail loading site. Upon arrival at the rail loading site, the containers would be transloaded to Articulated Bulk Container (ABC) railcars, a subset of a railcar type known as "articulated spine cars," using Rubber Tired Gantry (RTG) cranes. Soil would remain inside the containers at all times. ABC railcars typically have a capacity of six loaded containers.

Containers would be 20' long, with approximately 25 ton net capacity. Note that containers generally have a net capacity of approximately 32 tons, but the maximum gross weight of the trucks that move them between SSFL and the loading site would limit the load to approximately 25 tons. This equates to approximately 12-14 bank cubic yards of soil per container. Empty railcars would remain parked on the loading tracks, while trucks carrying loaded containers would drive on a roadway next to the appropriate railcar. An overhead gantry crane would lift the container off the truck and place it on the railcar. Empty containers returning from the disposal site would be removed from the railcars in the same manner.

The rubber tired gantry cranes operate on asphalt or concrete runways, straddling the tracks and the adjacent truck roadways. These RTGs are commercially available from several manufacturers in several different configurations. The RTG configuration (e.g., whether the RTG spans two tracks and one drive lane - as shown in the concept drawings, or spans one track and two drive lanes) is dependent upon several factors, including the final site configuration, truck arrival rates, and number of RTGs. This would be finalized during a subsequent phase of planning.

**Conveyor and Gondola Option**
If a conveyor system were selected, soil would be excavated and moved a short distance by end loaders or dump trucks to the conveyor feed point at the SSFL. The conveyor would move the soil to the rail load-out facility. At the rail load-out, soil would be deposited from the conveyor directly into gondola cars, which would subsequently be covered with tarps or lids. The conveyor outlet would remain stationary, while gondola cars would be moved in groups of 5 to 10 cars by a railcar mover (of the type commonly found at industrial facilities) under the conveyor outlet.

Gondola cars typically have a capacity of 100 to 105 tons (railcar rating for most railcar types is, by convention, expressed in tons, not volumetric capacity). This equates to approximately 54 to 57 bank cubic yards of soil. Soil density in the gondola cars can vary widely, depending upon the factor used to convert form bank cubic yards to loose material and the moisture content of the material.

The railcar loading area, specifically the location where the conveyor would discharge into the gondola cars, could be enclosed in a building or shed to prevent escape of dust. If need be, one car could be loaded at a time, disconnected from the remaining cars in the train with the doors on the shed closed. This could allow the loading shed to operate at negative pressure or with a wash-down system, ensuring no dust would escape during the loading process. The gondola cars themselves can be fitted with tarps or rigid covers, or even a completely sealed interior liner system. Some manufacturers of rigid covers represent that their systems meet USDOT criteria for transportation of low-level radioactive materials. Tarps may also meet those criteria.

Note that it would be possible for a hybrid configuration to be employed, where a conveyor moves soil from SSFL to the rail load-out site. At the load-out, the conveyor would deposit soil in containers, which would then be loaded onto ABC railcars. This would increase the amount of handling for the soil, but offers flexibility because not all destination disposal sites are capable of receiving gondola cars.

The images below illustrate different types of railcars and an example of a rubber tired gantry.

Photo 1 (below): Articulated Bulk Container (ABC) Railcar loaded with six 20' containers

Photo 2 (left): Rubber Tired Gantry lifting container onto truck chassis. Photo 3 (right): Gondola railcar.

Transportation options between SSFL and the disposal site, as well as railcar type selection and railcar loading site layout, depend on a number of factors, including:

A. The configuration of the excavation sites
B. The suitability of roadways for heavy truck traffic, or the ability to construct new roadways and the suitability of the terrain for conveyors

C. The rail access configuration of the disposal site; i.e., whether it is rail accessible, and whether it can handle gondolas, containers, or both
D. Cost (both operational and maintenance)
E. Site configuration and property availability for rail load-out
F. The risk for dispersing contamination
G. The environmental documentation process, impacts, and mitigation considerations (greenhouse gas generation is now a consideration, which tends to favor rail over truck haulage)
H. Public perceptions

It is evident that many of these factors are interrelated. In particular, the railcar type selection and the loading site configuration must match, since a site configured only for gondola cars could not handle ABC cars. Thus, the type of railcar used and the site configuration should be chosen together. More detail on each factor is provided, below.

**A. Configuration of Excavation Sites**

For example, consider an excavation scenario where the material is to be excavated from many geographically disparate locations at SSFL, and full containment of the material is necessary at all times. Such a scenario may favor to use of containers, since they can be brought by truck to each excavation location, eliminating "double-handling" of the soils. The container would then be hauled to the rail loading facility and placed on an ABC railcar for movement to the final destination.

If a conveyor were chosen for the same scenario, it might require frequent relocation of the conveyor feed hopper in order to serve the disparate excavation sites. Otherwise, intermediate haulage of material from the excavation locations to the conveyor feed point would be required.

Conversely, if the excavation scenario involved only a few locations at SSFL, it may be cost effective to bring the material to the conveyor feed point. This may require repositioning the conveyor feed point only three or four times during the life of the project. However, at the rail loading facility, the conveyor could discharge the contaminated soil directly into gondola cars, which have a higher capacity than ABC cars.

**B. Suitability of Roadways for Truck Traffic/Suitability of Terrain for Conveyors**

The choice of railcar type is contingent upon the type of transport between SSFL and the rail loading site. Conveyors favor gondola cars, while truck haulage favors containerized handling of the soils.

A conveyor option implies a relatively straight route between SSFL (where soils would be loaded on the conveyor) and the rail load-out site. Ideally, the conveyor would have only a few angle points and maximum grades on the order of 20%-25%. The hazardous nature of the excavated soil also implies that the conveyor would be fully enclosed in galleries.

For a truck option, the condition of existing roadways and the need for improvement to accommodate large numbers of loaded and empty trucks (including possible realignment, re-profiling, drainage improvements, pavement reconstruction, effects on other traffic, etc.) would need to be considered.

**C. Rail Access at Disposal Site**

Under any circumstances, the disposal site must be located along a rail line if it is to receive material in gondola cars. Based on the report "Feasibility Study – Alternative Contaminated Soil Transport and Disposal Options at Santa Susana Field Laboratory" (CH2M Hill, 2013) the only site meeting that criterion is Clive, Utah. However, other sites not mentioned in the report are rail-accessible, such as Waste Control Specialists in Andrews, TX, and may be able to receive soils from SSFL. The Department of Energy also has a hazardous (radioactive) disposal site near Green River, UT (though this site may only be cleared for contaminated soils generated at Moab). It is not known whether these other locations would be willing or able to accept the type of materials generated at SSFL.

For those disposal locations not located along a rail line (such as La Paz, AZ), containerized rail haulage of waste would be an option. Containers could be loaded on railcars at the loading site, removed from railcars at the nearest rail siding to the disposal location, and placed on trucks for transport the final distance to the disposal site. It is unlikely that shipping material in gondola cars to a rail siding near the disposal location, then transloading material from a gondola car to a truck for the final miles to a disposal site would be cost-effective.

It is conceivable that, under some circumstances, it might be cost effective to use a conveyor to move material from SSFL to the rail loading site, then load the material in containers at the rail loading site, thereby making it possible to access non-rail-served disposal facilities. However, such an alternative would be accompanied with comparatively high capital and operating costs. A slightly different type of rail equipment may improve the economics of such an alternative.

**D. Cost**

Minimizing the *total* cost of transport is crucial. Many projects seek to minimize cost of only one component of the overall logistics chain (such as capital cost of the loading facility), but in the process inadvertently increase costs of other parts of the logistics chain. For example, a decision to minimize the cost of transport from the excavation site to the rail facility (say, by choosing containers hauled by trucks, rather than a conveyor) also forces use of ABC railcars capable of handling containers. However, ABC cars tend to result in a high rail rate transportation cost because they can carry less cargo than gondola cars, as well as a higher car acquisition and/or lease rates than gondola cars. Over time, these higher transportation costs may outweigh the lower capital cost of the truck option.

Both capital and operating costs would need to be considered. Such an analysis would require additional design, and identification of the following costs:

- Refinement of shipping volumes, and a more detailed production profile for the life of the project (at minimum, identification of the maximum shipping rate on a daily and weekly basis in order to determine limiting train schedules).
- Real property acquisition/lease costs
- Identification of transportation costs from SSFL to the rail loading site via truck and via conveyor.
- Identification of the disposal site cost structure, including disposal costs (since different disposal sites may charge vastly different amounts to handle and dispose of the waste generated).
- Identification of transportation costs from the rail loading site to the final disposal site by gondola.

- Identification of transportation costs from the rail loading site to the final disposal site by articulated bulk container.
- Identification of railcar lease or acquisition costs for both types of railcar (gondola and ABC).
- Identification of the number of trainsets of railcars required (based on cycle time to disposal site and return).
- Identification of truck costs between SSF and the disposal site (for comparison to rail costs).
- Facility removal and clean-up costs after the project is complete, and possible credit for resale of marketable equipment (such as railcars and track material).

The transportation costs from the rail loading site to the final disposal site depend upon a number of factors and can vary widely. However, several large shippers in the Los Angeles area have found that, for distances over 100 miles, rail is the most cost-effective option for movement of bulk materials.

**E. Site Configuration at Rail Load-out**

The ability of the rail loading site to accommodate either containers or gondolas is also a consideration. The site configurations will be discussed in detail in a later section, but, briefly, the gondola option will require a much smaller footprint than a container option. The gondola option would probably also result in lower rail shipping costs.

As noted previously, the gondola configuration is best matched to the conveyor option, while the ABC/container option is best matched to the truck and container haulage option. However, to be conservative, both site concepts have been developed to illustrate a container configuration. While a gondola option would have a smaller footprint (and thus easily fit inside a footprint smaller than the container option), it appears that either mode is feasible at either site.

**F. Risk for Dispersing Contamination**

Both the conveyor and container modes present risks for dispersing contamination. Conveyors can be surrounded with enclosed galleries to prevent dust release.

If containers are selected as the method of transport, they can be covered with close-fitting tarps. However, the trucks carrying containers would collect dust from the excavation areas that could be tracked off-site along roadways.

Gondola cars can be fitted with tarps or rigid covers to contain materials. Gondola cars can also be equipped with interior flexible liner systems that completely seal the materials inside.

**G. Environmental Documentation Process**

The environmental documentation process for the rail loading facility would be incorporated into the overall environmental document for SSFL cleanup, likely an Environmental Impact Statement at the federal level. It is not known whether federal preemption would apply to this project, and thus unknown whether an Environmental Impact Report would be required under the California Environmental Quality Act. In order to complete documentation for the rail load-out facility, additional design would be required. A final choice of transport options (gondola or ABC car) is likely not necessary to complete the documentation.

**H. Public Perceptions**

The perception of public stakeholders will be key to selecting a preferred alternative during the environmental documentation process. Transportation of contaminated soils is a highly visible issue, since it implies bringing such soils close to the public.

The presence of large highway trucks, with the attendant noise, congestion, and greenhouse gas emissions could be a hot-button issue for the public. This could be mitigated by a conveyor system; it is possible that a conveyor system could approach either loading site from the west, away from residences. Indeed, it is possible that a conveyor system could be routed parallel to, or even over the new spur tracks in order to reach an access point away from residences. Such routing would need to be developed in conjunction with additional site survey information.

## IV. Rail Operation

Common to nearly all rail operations is the need to avoid interrupting main line operations with the switching of railcars on the main line. This premise drives the track configurations and operational patterns at both candidate sites. Please refer to the attached Conceptual Layouts for Sites 1 and 2B, which illustrate the respective track configurations.

The main line at Santa Susana is owned and dispatched by the Southern California Regional Rail Authority (SCRRA, also called Metrolink), which operates many high-priority passenger trains. SCRRA effectively controls the ability of freight trains to access industries along the line. Any new freight operations will be required to comply with SCRRA's operational requirements to ensure uninterrupted passenger train operations.

The freight service on this line is provided by a separate entity, Union Pacific Railroad (UPRR), which owns the franchise to provide freight service on this portion of SCRRA's tracks. Thus, in addition to meeting SCRRA's requirements, track configurations and switching operations must also meet Union Pacific's requirements. Please note that neither SCRRA nor UPRR has been engaged in discussions regarding the service; the design team has used its previous experience (team members have designed multiple facilities for both SCRRA and UPRR) with both these entities agencies to develop the concepts.

Concepts for both Site 1 and Site 2B keep freight switching off the main line by constructing a new lead track parallel to the main line, between the main line and the movie studio buildings. Based on aerial imagery, there appears to be adequate space for such a track. Right of way acquisition may be required. This track will allow trains in the yard area to make "back-and-forth" switching movements required for loading (especially those movements associated with moving gondola cars to the conveyor loading area) without occupying the main line.

Note that the lead track for both concepts is accessed only from a turnout configured to allow *eastbound* trains to enter the site. This configuration was selected because, without detailed survey of the track alignment west of the tunnel portal, significant reconfiguration of the existing tracks would appear to be required in order to allow a train to enter either site from the east. This is an important consideration, since it limits the manner in which Union Pacific trains can access the site.

At this time, it is assumed that most disposal site locations would be located on the rail lines extending eastward from the site. Thus, empty trains arriving from the east (Van Nuys) can arrive at the switch to the site and then back-in to the site. However, because of the geometric limits to the track configuration, the locomotives would only be able to couple-on to the west end of the train. Thus, loaded trains would be required to pull out of the facility pointed westbound (with the locomotive at the front of the train). The locomotives would then park the loaded cars in the siding at Santa Susana to enable the locomotive to "run around" the train on the main line, in order to get to the east end of the train and enable an eastbound departure. This operation would require a great deal of main line and siding occupancy, and could only be performed at night, when passenger trains do not operate and there are relatively few freight trains.

Alternately, trains may need to depart Santa Susana westbound, and may have to proceed as far west as Oxnard. At Oxnard, locomotives would be moved to the other end of the train ("run-around" the train), thus allowing the train to proceed eastbound (and passing-by the loading site) to its final destination. This would increase operational complexity and costs, but may be necessary to avoid switching on the siding and main line.

**Facility Shipping Capacity**

Based on the track configuration proposed at the rail loading site, the maximum train length would be approximately 3900'. At either site, the controlling length is the distance between the turnout which connects the loading tracks to the existing SCRRA siding and the end of track near the tunnel (at Site 2B, this is approximately 3900', at Site 1, this is slightly less). It is in this distance that a single train can be "built" by combining loaded cars from individual loading tracks. Once a train is built, locomotives would couple-on to the west end and pull the train out of the loading area.

This available length (essentially the same for both Site 1 and Site 2B) should be able to accommodate a train of approximately 70 gondola cars containing approximately 7350 tons of material, or approximately 3970 bank cubic yards of soil per train. If ABC cars were used, this track length would accommodate a train of approximately 41 ABC cars, holding 245 twenty foot bulk containers, or approximately 6125 tons of material, or approximately 3300 bank cubic yards of soil per train. Please bear in mind that these quantities are approximate, dependent upon the empty weight of the cars used, the weight of the covering system, the final track geometry, space required for locomotives, operational considerations, and other factors.

Note that, depending upon operational allowances by SCRRA and Union Pacific, the track configuration at Site 2B could allow for the cars on four tracks (rather than on just two tracks, as has been assumed) to be loaded in the facility, and subsequently assembled into a longer train by Union Pacific crews just prior to departure. This would require UP train crews to use the SCRRA siding for switching. However, it would essentially double the capacity of each train. This "best case" operational allowance could be explored further with the railroads.

Also note that, because of the need to allow space for locomotives (which are only on-site during arrival and departure operations, but not necessarily during loading operations), the possible train lengths indicated here are less than the sum of the individual track capacities indicated on the conceptual plans. The additional loading track length would be used to store spare railcars, railcars needing repair, etc., at the extreme end of each track. Depending upon the final scale of the operation and required reliability, it may be beneficial to have separate short track for such repair work.

At the destination (the selected disposal site), the track configuration and unloading apparatus must match the size and type of train that originates at Santa Susana. For example, the disposal site must be able to handle a unit train approximately 4000' long. And, as mentioned previously, the type of unloading equipment must match the railcar type (gondola or ABC).

Assuming soil would be delivered to the loading site at the rate of 1000 CY to 2000 CY per day, approximately 1 -2 trains per week would need to depart the loading facility. If the "best case" operational allowance were assumed for Site 2B, only one train per week would need to depart the facility.

**Site 1 Operations**

Individual sections of a single train could be stored in the five loading tracks. A railcar mover (which is a small, 4-wheel locomotive equipped with retractable tires so that it can drive on roadways) would position itself at the west end of each spur and, as the first group of cars was loaded, push this group of cars east toward the earth bumper at the end of the long lead track. The car mover would then return and position itself at the west end of another spur track, waiting until the cars on that track were loaded, at which point they would also be pushed eastward, to couple to the section of cars already standing on the long spur track. This would be repeated until all cars were assembled into a train on the long lead track. This procedure would be performed in reverse to disassemble an arriving empty train and store its cars on the five loading tracks.

Once a train was assembled, Union Pacific locomotives would then arrive to pull the train away. Note that, at Site 1, there is no room to drop-off an empty train when the loaded train is already waiting to be picked-up. This suggests that an empty train would have to be dropped off one day, Union Pacific would store the locomotives at Van Nuys or Oxnard, and then return several days later to pick-up the loaded train. Alternately, an empty train would be stored in a Union Pacific yard until the loaded train was picked-up and departed for the disposal site. At that time, there would be empty tracks available in which to place the empty cars (which would be brought from the Union Pacific yard by a second set of locomotives). Due to the extra switching, poor utilization of locomotives, and necessity to use tracks in Union Pacific's yard, operations at Site 1 would be accompanied with higher costs than at Site 2B. It would also increase the time during which there was no train on site ready to receive soil, and require closer coordination with Union Pacific.

**Site 2B Operations**

The concept drawing for Site 2B illustrates four long loading tracks. Note that Loading Tracks 3 and 4 are shown as "optional". Although the site could operate without them (and thereby reduce capital cost, right-of-way acquisition, overall footprint, and environmental impacts), the most efficient operation would be available if all four loading tracks were constructed.

Assuming all four tracks were available, a train of approximately 4000' total length would be broken into two sections, one each on Loading Tracks 1 and 2. After being loaded, one section (say, that on Loading Track 2) would be pulled westward (either by an on-site switch engine, car mover, or by Union Pacific's locomotives) and then pushed back eastward to couple to the section on Loading Track 1. At this point, the train would be ready for Union Pacific locomotives to arrive to couple to the train and depart westward. As noted previously, the train would initially depart westward, but would soon be placed into

a siding where the locomotives could “run-around” the train to pull it eastward towards its final destination.

Because four tracks are available (each track with capacity for one half a train), when the Union Pacific locomotives arrive, they could bring an empty train from the east. They would first push the empty train into the two unoccupied loading tracks (in the previous scenario, Tracks 3 and 4). Then they would collect the loaded cars from Tracks 1 and 2 into a train ready for departure. Because there are sufficient tracks to hold both a loaded train and an empty train, this makes extremely efficient use of the locomotives and Union Pacific crew. The empty train would not need to be stored off-site. This scenario would present the lowest operational costs.

If Tracks 3 and 4 were not constructed, there would be no “empty” tracks available when Union Pacific locomotives arrived to pull away the loaded cars. Thus, the operational scenario would be similar to that for Site 1, where trains are stored off site until space is available. Although this lack of operational capacity would increase operating costs, though Site 2B would still offer a simpler, more flexible operation than Site 1.

## V. Site Design Considerations

Both sites were designed to comply with Union Pacific and SCRRA engineering standards. They also comply with regulatory standards of the California Public Utilities Commission pertaining to railroads.

The conceptual layouts for both sites are premised upon a hybrid scenario including containers, ABC cars, and RTGs because such a hybrid scenario requires widely spaced tracks and large paved areas and thus produces the largest footprint for ether site. The hybrid container and ABC car scenario also likely has the highest capital cost.

An operation using only conveyors and gondola cars at either Site 1 or Site 2B would have a significantly smaller footprint than that shown in the concept plans for either site. With only gondola cars, the tracks could be spaced more closely because driveways for trucks and RTGs would not be required. It is possible that the footprint for a gondola-only operation could be half the size shown in the conceptual plans.

For an ABC and container operation, paving would have to be sufficiently deep to support heavy truck traffic, as well as the high loadings from the RTGs. It has been assumed that the temporary nature of the facility would allow asphalt to be used for the RTG runways where the RTGs impose high wheel loads on the pavement (concrete is typically used for RTG runways at permanent, high-usage intermodal yards).

The paved area at both sites includes a small area for storage of spare containers and container chassis (assuming use of ABC railcars and containers, rather than gondolas) and vehicle parking. However, it is assumed that most container, truck tractor, and chassis storage would occur at the SSFL site.

It appears that two structures associated with stormwater could be affected by the layout for Site 1. They would almost certainly be affected by the layout for Site 2B. The ownership and exact function of these structures has not yet been determined, though they are fed by a small-capacity power service. Absent information on these structures, $2 million has been allowed for relocation.

Stormwater structures near the entrance to the railroad tunnel.

Note that there have not yet been any investigations of right-of-way/property boundaries, easements, utilities, survey-level topography, geotechnical considerations, or drainage. Nor have there been discussions with the connecting railroads to confirm/refine operational concepts.

It has been assumed that SCRRA would allow use of a narrow strip of their ROW for the long lead track via a lease or license for the duration of the project. Tracks on the site have been spaced at least 20' from the nearest SCRRA track.

A conceptual-level typical section has been provided to illustrate the width of Site 2B. It is general similar to Site 1, though the geometry for site 1 includes a fifth loading track which is not represented in the typical section.

**Local Permitting**
The local land use authority will likely require a conditional use permit for temporary use of Site 1 or for use of the Corriganville Park property for Site 2B. This process will involve both costs and time and the progress of the conditional use permit is, in part, dependent upon the local authority's perspective on the SSFL cleanup project. Once a conditional use permit is secured and NEPA/CEQA documentation is complete, obtaining other permits (for example: building, grading, and sewer connection permits) should be a relatively straightforward process.

Other than the right of entry permit for engineering design and for construction, SCRRA does not require a construction permit. However, Ventura County (owner of the SCRRA right of way) will require a lease or license for use of approximately 2.5 to 3 acres of their right of way.

**Construction Considerations, Conceptual Construction Duration**
Construction considerations, types of construction activities, and construction schedule for each site would generally be similar.

General civil construction would involve earthwork, construction of drainage facilities (catch basins and associated piping), substantial paving (if a container and truck operation were selected), and extension of utilities (power, water, storm sewer, sanitary sewer, and telephone) to the site.

Minor structural construction for retaining walls may also be necessary, though these could likely be cast-in-place concrete walls, with shallow footings installed by excavators, but without the need for pile driving equipment. A small railroad bridge may be required (to match an existing railroad bridge and provide equal conveyance capacity). This would likely be constructed of precast members, though the

substructure may involve CIDH shafts, or possibly limited pile driving activities. It is also possible that this drainage could be spanned with culverts. Additional hydraulic analysis would be required.

It has been assumed that stormwater would need treatment before being conveyed to a municipal or county system. It is unknown want provisions for treatment would be required for contaminated soil, but an allowance of $1.5 million has been included for a treatment facility.

Given the relatively temporary nature of the facility, site lighting would likely be provided by high pressure sodium lights mounted on wood poles.

At the end of the SSFL cleanup, it is assumed that the railcar loading sites would need to be demolished and the ground restored. Some site remediation would likely be required. Although sale of the real property could generate revenue, to be conservative, no credit for the real property sale has been included. Note that, except for changes in value of the real property and discounted Net Present Value, sale of the real property should approximate its acquisition cost, thereby making property acquisition an approximately zero net cost aspect of the project.

Railroad track and signal construction would involve common earthmoving equipment, as well as railroad tampers and ballast regulators. This equipment, and the 4-8 person crews to operate it, would likely be on site for approximately 2 months.

Assuming a construction duration of 8-12 months, it is likely that 5-10 persons, their personal vehicles, and several pieces of heavy equipment to handle the heavy civil construction would be on site at any time. Examples of the civil construction equipment include bulldozers, loaders, compactors, excavators, cranes, forklifts, motor graders, dump trucks, asphalt pavers, etc. The quantities and types of equipment will depend, in part, upon whether a gondola or ABC and container operation is selected and the unique types of infrastructure associated with each. The construction duration could be reduced to as little as 6-8 months, though daily staffing requirements would likely increase.

**Site 1**

Site 1 is in a relatively flat area which is currently largely vacant. Several small structures and mobile homes are on-site, implying possible relocation of residents would be required. It has been assumed that the entire vacant parcel at the corner of Kuehner Drive and Smith Road would be purchased for the project. It is also closest to the residential neighborhood on the west side of Kuehner Drive, as well as residences on the south side of the tracks. This implies noise and light reduction measures, and places a premium on dust control.

As illustrated in the Conceptual Layout, Site 1 involves five short loading tracks. For a container and ABC car scenario, these tracks would be surrounded by paving to allow truck and RTG access along each track. If conveyor loading were used, the loading shed could be located near the turnout separating the loading tracks (as shown in the concept plan), or a separate track could be constructed specifically for the loading shed (not shown). If only gondola cars were used, with no need to accommodate trucks and RTGs, the tracks could be spaced more closely together. It may be possible to add sufficient tracks so an empty train could also be accommodated while a second train was being loaded, though this possibility has not been explored.

A single track which, given the track configuration in Site 1, would be referred to as a switching lead or a pullback track, extends adjacent to the SCCRA right of way towards the entrance to the railroad tunnel. This track allows sufficient space for trains to arrive and depart, as well as a place for switching movements to occur. This track may be located partially on the edge of SCRRA right of way (actually owned by Ventura County), and may also be located partially on adjacent properties. Ownership would not be known until additional survey and design is complete, and discussions are initiated with SCRRA/Ventura County about temporary use of their property during the life of the project. Constructing this track would require lengthening several culverts, possible small retaining walls in the narrow area between the SCRRA track and the warehouse and movie set properties, and possible relocation of the concrete stormwater structures near the east end of the track. It may be possible to route the track around these stormwater structures and avoid relocation entirely.

The conveyor belt (if conveyor is used between SSFL and the loading site) would have to enter from the south, implying that it would either be routed through residential areas, or it would have to be routed to the east, then along the north side of the tracks (or possibly on structure over the lead track) to reach the loading area.

From an operational perspective, this site offers the least flexibility and highest operating costs. It also requires a railcar mover to be located on-site in order to build trains ready for pick-up, or to distribute empty cars into the loading tracks.

**Site 2B**

Site 2B is a narrow site, also in a relatively flat area. This site is located farther away from residences than Site 1. Most of the loading area would likely be entirely out-of-site (or nearly so) from the majority of nearby residents. Site 2B would likely involve some degree of encroachment onto portions of Corriganville Regional Park as well as onto the SCRRA/Ventura County right-of-way. At this, conceptual level, we believe the only permanent impacts to the park would be trimming or removal of trees. Note that the level of impact to the park would depend upon whether the “optional” Loading Tracks 3 and 4 were constructed, and whether gondola cars or ABC cars and containers were employed; an operation using only conveyors and gondola cars would have a significantly smaller footprint than that shown in the concept plan, since tracks could be spaced more closely, and driveways for trucks would not be required.

It has been assumed that the footprint outside of the SCRRA/Ventura County right of way would have to be purchased from Corriganville Park. However, it may be possible to obtain a lease for this property at somewhat lower cost than an outright purchase.

The lead track, which connects to the SCRRA siding track near Kuehner Drive, will require lengthening several culverts, and possible small retaining walls in the narrow area between the SCRRA track and the warehouse and movie set properties. To make room for the four loading tracks, there will be general grading, as well as and relocation of the concrete structures near the east end of the track (associated with a stormwater facility). If only a two-track operation, or gondola-only operation were selected, it may be possible to route the tracks around these structures.

The conceptual plan (and the conceptual cost estimate) illustrate a facility with four loading tracks. As mentioned previously, note that Loading Tracks 3 and 4 are indicated in the plan as “optional,” and have a different line type to distinguish them from Loading Tracks 1 and 2. As described in the section on Rail

Operation, Loading Tracks 1 and 2 represent the minimum number of tracks for a functional facility. The facility will operate more efficiently if all four tracks were constructed, although it is possible that it could operate with only two tracks if capital costs or environmental issues are concerns. If all four loading tracks were constructed, two RTGs would likely be necessary to foster the most efficient operation. If only two loading tracks were constructed, only one RTG would be necessary.

## VI. Conceptual Capital Cost Estimate

A conceptual-level, rough-order-of-magnitude (ROM) capital cost estimate is attached. Please note that this estimate has been developed based only on a single site visit and the level of horizontal design indicated on the conceptual plans. No subsurface investigations, utility investigations, field survey, right of way investigations, drainage design, assessment of existing structures, hazardous materials investigations, or environmental mitigation studies, etc., have been performed at this stage of development. Costs are based on current typical cost in the industry, and the design team's experience with similar facilities.

The conveyor system has been estimated beginning at the railroad right of way. The conveyor to SSFL, or the alternate roadway improvements for a track and container operation, are not included in this estimate.

Costs for railcars have not been included, since these are dependent upon the type of system selected, the number of railcars needed, and whether the railcars would be leased or purchased. Each of these parameters is, in turn, a function of the final destination for the material (ie, location of disposal sites) and the rail operating plan.

To present a worst-case scenario, the cost for *both* RTGs and for a conveyor and loading shed has been included. *Note that these costs are mutually exclusive if an operation involving only gondola cars or only ABC cars were selected.* If a gondola-only option is selected, the rubber tired gantries and paving would be unnecessary. If an ABC and container option is selected, the conveyor and loading shed would be unnecessary. However, if a hybrid option involving a conveyor to move material from the SSFL site to the rail loading site, and rail transport by container (rather than gondola car) were selected, both RTGs and a conveyor shed may be necessary. Thus, both have been included in the cost estimate. This assumption should help to make the cost estimate conservative.

To reflect the current level of design, a 35% contingency has been included "below the line." Soft costs, such as administration, environmental permitting, design, railroad coordination, and construction management, have been included as percentages of the capital cost. Although actual size of property acquisitions have not been determined, real property costs, based on assumed acquisition sizes, have been estimated at $150,000 per acre, since the parcels under consideration appear to have only minor improvements.

Permits (such as grading permits, site development permits, building permits, etc.) have been estimated at 3% of the capital cost. No development impact fees have been included. These could be necessary to offset the cost of roadway upgrades/repairs if significant heavy truck traffic were routed onto roadways which were not designed for such traffic.

To reflect the current level of design, the final ROM capital costs have been expressed as a range. The "low" end of the range is 30% *below* the estimated capital cost (including contingency). The high end of the range is 30% *above* the estimated capital cost (including contingency).

Operational costs (such as rail shipping charges, trucking charges from SSFL to the rail loading site, etc.) Have not been included.

The range of conceptual costs for Site 1 is: $32.4 million to $60.2 million

The range of conceptual costs for Site 2B is: $31.4 million to $58.2 million

Again, note that the estimates for Site 1 and Site 2B include infrastructure for *both* a conveyor operation *and* a container operation. This is an unlikely combination that requires infrastructure for both systems. Costs would be reduced significantly if additional definition were provided in order to select either a gondola or container operation. By selecting one mode option or the other, costs for each Site would be reduced by approximately $4-$7 million. For Site 2B, if the "optional" loading tracks were omitted, leaving only two tracks remaining, an additional $2-6 million would be saved. This could make Site 2B significantly less expensive than Site 1. Additional definition could also allow a reduced contingency.

## VII. Next Steps

The following outlines the next steps in order to develop, permit, and construct the rail transload facility. This outline assumes that the client does not have a specific project development structure for a railcar facility. However, note that the development of this facility is interrelated with the overall development of the cleanup plan for SSFL, and specifically related to the materials transport methods off the SSFL site (e.g., conveyor or truck).

1. **Commercial Evaluation:**
   Evaluate combinations of material volume, disposal site/railcar destination, railcar type, and material handling selection (i.e., between SSFL and the rail load-out). Develop preferred alternatives from a commercial perspective based on initial review in order to narrow the range of alternatives. Preliminary freight rate costs, railcar costs, and site capital costs (including transport to SSFL) are inputs to this evaluation.

   The result will identify costs and benefits, determine which, if any, external costs and benefits will be monetized; develop benefit/cost analysis.

   Duration: 3-4 months. Could commence as soon as haul mode between SSFL and the rail loading site is determined, though the configuration of the rail site and haul mode are, in fact, interdependent and should proceed in concert as part of the commercial evaluation. It may be possible to commence preliminary discussions with additional engineering based on the information developed as part of this study.

2. **Initiate Access Process with Railroads (Union Pacific, SCRRA) and Refine Conceptual Design:**
   Initiate discussions for establishing service with Union Pacific (UPRR). UP has a new service process that commences with conceptual design. This would require advancing the concepts presented with this document, and refining track geometry. This could be performed based on aerial imagery, but since the design relies upon fitting a track between the existing SCRRA track and buildings, to ensure the viability of the concept, field survey would be highly desirable. A

right-of-entry and railroad flagging from the track owner, SCRRA, would be required to perform field survey.

Union Pacific's process proceeds through design reviews of 30%, Final Design, and Track Agreement documents. Right of Way information is needed for the submittals to UPRR. This process does not lend itself well to design-build efforts related to the railroad track design and right-of-way acquisition. UPRR and SCRRA will prefer design-bid-built, at least for the railroad-related components of the project.

Union Pacific will also ultimately require agreement with commercial terms (i.e., freight rates). Prior to entering this negotiation, it is necessary to know the destination (or being forced to request rates to multiple destinations); the railcar type; whether railcars will be supplied by the railroad or private cars would be purchased or leased; the length of train; the weight of each train; the travel time desired to the destination; the level of hazard of the cargo; the frequency of service; and the operational characteristics of the service.

SCRRA rarely deals with new freight customers, but will require at least 30%, 60%, and 100% submittals for approval. SCRRA approval is critical since they own the tracks, provide passenger service, and dispatch the trains (though Union Pacific has freight rights in this area). The concept is predicated on a connection with SCRRA track and signal systems, and also use of a portion of SCRRA/Ventura County property, likely by lease or easement.

Overall duration of railroad access and freight haulage agreements: 4-8 months. Completion contingent upon final PS&E design (since final plans are a milestone for Union Pacific and SCRRA) and negotiations with Union Pacific. Could commence as soon as railcar type and destination(s) are determined and proceed concurrent with other activities.

3. **Environmental Documentation and Permitting:**
Incorporate railcar load-out into the overall environmental NEPA/CEQA documentation for the SSFL remediation. Ensure railcar load-out is considered by the purpose and need statement. Since this is a related action, it is unlikely that the environmental documentation for the railcar load-out could proceed independently (unless a Programmatic document is pursued). At least two alternatives will need to be evaluated as part of the NEPA/CEQA process.

A conditional use permit would likely be required from the local land use authority in order to employ the site for non-zoned use. This process typically is performed in conjunction with the NEPA/CEQA process. Site use permits for grading, construction, drainage, etc., are contingent upon receipt of the conditional use permit.

Duration: unknown. Highly dependent upon status of other SSFL permitting efforts. For reference, permitting the rail site as a stand-alone project would likely require 8-18 months, depending upon environmental impacts.

4. **Perform Preliminary Engineering:**
To support the NEPA/CEQA documentation process, develop preliminary designs. A key part of this will be to identify potential impacts for the environmental documentation. To do so with confidence requires survey and at least preliminary design. Some level of preliminary design for both sites (Site 1 and Site 2B) is likely required in order to satisfy the need to develop alternatives for the environmental documentation. This would identify not only track layout and footprint for the environmental process, but also refine the site layout, vehicle circulation at the site, and material flow through the site. The same preliminary engineering effort could satisfy the early stages of the Union Pacific and SCRRA approval processes.

5. **Final Design:**
   This would include final PS&E. A choice of site selection would be made at this level, or may have been made prior to commencing PS&E. This would include site design, drainage design, utility relocation, relocation of the stormwater structures, railroad track design, pavement design (for the truck option), and conveyor system design (for the gondola option). This effort would also include third party coordination for relocation of utilities, stormwater, etc. Final design could also include equipment selection and procurement (e.g., for rubber-tire gantry cranes).
   Duration: 4-8 months, assuming project scope is well defined at commencement of PS&E and survey is already available.

6. **Procurement and Construction Management:**
   Procure a contractor, procure equipment. Manage the construction process. Commission the completed project.
   Duration: 6-12 months.

The overall schedule, from initiating commercial evaluation to completion of final design, would likely be 12-24 months. Construction would take 6-12 additional months. Commercial Evaluation, Environmental Permitting, and coordination for relocation of the stormwater structures are likely the critical path items, though many items could proceed in parallel. RailPros' team has experience with each of these phases of work, and has recently obtained approvals from Union Pacific for several industrial facilities (both large and small) as well as main line relocations for UPRR and also for SCRRA.

If Environmental Permitting were removed from the timeline (for example, if environmental clearances were obtained as an addendum to an existing environmental document for the SSFL site remediation), commercial evaluation, coordination with the railroads, design, and construction, and commissioning of the rail loading facility could be completed in as little as 12-18 months.

## VIII. Conclusions

This study has determined that it would be feasible to establish a location where soils could be loaded onto railcars at either Site 1 or Site 2B. It would be feasible to ship soil from SSFL to the rail loading site either by conveyor or by truck, in bulk shipping containers. Rail transport could occur with the soil loaded into sealed gondola cars, or with the soil inside bulk shipping containers loaded, which would then be transloaded directly from trucks to railcars at the site.

Because the corridor has many passenger trains, operational constraints for freight trains serving either site do exist. However, it is believed that the trackage on either site could be configured to mitigate the operational constraints.

Key next steps would be to engage the affected railroads, determine whether conveyors or containers would be used to move material from SSFL to the rail loading site, refine cost estimates, and commence environmental documentation and permitting.

# CONCEPTUAL BUDGET ESTIMATE - SSFL RAIL SITE 1

Location: **Santa Susana, approx MP 440, SCRRA Ventura County Subdivision**
Project Name: **Santa Susana Field Laboratory Rail Logistics Study**
**Site 1**

By: RailPros
Date orig: August 19, 2015
Revision#:
Date:

**THIS ESTIMATE HAS A RATING OF:** ***2C*** *(See rating scale guide below.)*

**Scope:** **Santa Susana Field Laboratory Rail Logistics Study**
Conceptual cost estimate for Site 1. totals include costs for ***both*** gondola and ABC/container operations

**Assumptions** See report

**CONSTRUCTION**

| ITEM DESCRIPTION | EST. QUANT. | UNITS | UNIT PRICE | EXTENDED COST |
|---|---|---|---|---|
| Mobilization | 1 | PCT | 8% | $ 1,566,492.19 |
| Bonds and Insurance | 1 | PCT | 2% | $ 391,623.05 |
| *Rail* | | | | |
| Railroad Flagging | 50 | Day | $ 1,200 | $ 60,000 |
| Trackwork | 8,700 | TF | $ 270 | $ 2,349,000 |
| Turnouts | 7 | EA | $ 120,000 | $ 840,000 |
| Railroad subballast | 8,700 | CY | $ 55 | $ 478,500 |
| Tie-In at SCRRA Connection | 1 | LS | $ 100,000 | $ 100,000 |
| Railroad Signaling | 1 | LS | $ 500,000 | $ 500,000 |
| | | | *rail subtotal* | *$ 4,327,500* |
| *Sitework and Structures* | | | | |
| Clearing and Grubbing | 38.3 | AC | $ 8,000 | $ 306,152 |
| Earthwork (assumed 2' cuts and fills across paved area+retaining wa | 18,933 | CY | $ 30 | $ 568,000 |
| Retaining Wall (adjacent to buildings/movie set location. Assume 5' l | 1,000 | LF | $ 600 | $ 600,000 |
| Railroad Bridge PCCB (adjacent to stormwater facilities) | 30 | TF | $ 6,000 | $ 180,000 |
| Culvert Extensions | 1 | EA | $ 20,000 | $ 20,000 |
| Roadway Entrance (driveway approach, signage, guard shack, etc) | 1 | EA | $ 50,000 | $ 50,000 |
| Perimeter Security Fencing (Chain Link) | 11,000 | LF | $ 15 | $ 165,000 |
| Site Power | 1 | LS | $ 150,000 | $ 150,000 |
| Site Lighting | 1 | LS | $ 1,000,000 | $ 1,000,000 |
| Stormwater Conveyance | 1 | LS | $ 500,000 | $ 500,000 |
| Stormwater Treatment Facilities | 1 | LS | $ 1,500,000 | $ 1,500,000 |
| Water Connection | 1 | LS | $ 50,000 | $ 50,000 |
| Sewer Connection | 1 | LS | $ 150,000 | $ 150,000 |
| Utility Relocation (eg, fiber optic in SCRRA ROW, unkonwn utilities) | 1 | LS | $ 400,000 | $ 400,000 |
| Temporary Office/Job Shack | 1 | EA | $ 50,000 | $ 50,000 |
| Reconstruct/Relocate Existing Storwater Structures | 1 | LS | $ 2,000,000 | $ 2,000,000 |
| | | | *sitework subtotal* | *$ 7,689,152* |
| *Roadway Associated with Container Operation* | | | | |
| Paving/Hot Mix Asphalt (*average* depth: 9") | 11,800 | Ton | $ 95 | $ 1,121,000 |
| Aggregate Base Course (average uniform depth under HMA: 12") | 14,100 | Ton | $ 35 | $ 493,500 |
| Heavy-Duty Conc. Curb and Gutter (HMA perimeter) | 4,000 | LF | $ 25 | $ 100,000 |
| Misc. Striping and Signing | 1 | LS | $ 100,000 | $ 100,000 |
| Truck Scale (Above Ground, New) | 1 | EA | $ 100,000 | $ 100,000 |
| | | | *roadway/container subtotal* | *$ 1,914,500* |
| *Conveyor Associated with Gondola Operation* | | | | |
| Conveyor (elevated, enclosed galleries, 36" wide belt, max 1000 TPH | 250 | LF | $ 2,000 | $ 500,000 |
| Surge Bin (500 ton cap'y) | 1 | EA | $ 150,000 | $ 150,000 |
| Loading Shed with Dust Control | 1 | EA | $ 2,500,000 | $ 2,500,000 |
| | | | *conveyor subtotal* | *$ 3,150,000* |
| *Restoration* | | | | |
| Site Cleanup and Restoration at End of Project | 1 | LS | $ 2,500,000 | $ 2,500,000 |
| | | | *construction subtotal* | *$ 21,539,268* |
| **Construction Subtotal** | | | | **$21,600,000** |
| Property/ ROW Acquisition | 38.3 | AC | $ 150,000.00 | **$5,740,358** |
| **Right of Way Subtotal** | | | | **$5,800,000** |
| **Construction + ROW Subtotal (Construction + Property Acquisition)** | | | | **$27,400,000** |

# CONCEPTUAL BUDGET ESTIMATE - SSFL RAIL SITE 1

Location: **Santa Susana, approx MP 440, SCRRA Ventura County Subdivision**
Project Name: **Santa Susana Field Laboratory Rail Logistics Study**
**Site 1**

By: RailPros
Date orig: August 19, 2015
Revision#:
Date:

**THIS ESTIMATE HAS A RATING OF:** ***2C*** *(See rating scale guide below.)*

**Scope:** **Santa Susana Field Laboratory Rail Logistics Study**
Conceptual cost estimate for Site 1. totals include costs for ***both*** gondola and ABC/container operations

**Assumptions** See report

| | | | | | |
|---|---|---|---|---|---|
| **SITE MOBILE EQUIPMENT** | | | | | |
| | Site Mobile Equipment | | | | |
| | Rubber Tired Gantry, Diesel Powered, New | 1 | EA | $ 750,000 | $ 750,000.00 |
| | Container Yard/Chassis Hostler Truck, New | 1 | EA | $ 45,000 | $ 45,000.00 |
| | Railcar Mover, New | 1 | EA | $ 200,000 | $ 200,000.00 |
| | | | | *subtotal* | *$ 995,000.00* |
| | **Mobile Equipment Subtotal** | | | | **$1,000,000** |
| | **Capital Cost Contingencies (*Applied to All Cost Items, Incl. Property + Equipment)*** | | 35% | | **$ 9,940,000** |
| | **Capital Cost Subtotal** | | | | **#########** <---------- |
| **PROJECT DEVELOPMENT & SUPPORT** | | | | | |
| | Local Permits (% of Construction Subtotal + related Contingency) | | 3% | | $ 870,000 |
| | Ventura County/SCRRA ROW Lease | | LS | | $ 80,000 |
| | Project Management (% of Capital Cost Subtotal) | | 3% | | $ 1,150,000 |
| | Environmental Documentation (NEPA/CEQA) (% of Const. Subtot. + related C | | 5% | | $ 1,460,000 |
| | PS&E, Operations Planning (Site & Rail) (% of Const. Subtot.+ related Contin | | 8% | | $ 2,330,000 |
| | Railroad Coordination (% of Construction Subtotal + related Contingency) | | 0.25% | | $ 70,000 |
| | Construction Management (% of Construction Subtotal + related Contingency) | | 7% | | $ 2,040,000 |
| | | | | *subtotal* | $ 8,000,000 |
| | **Project Development Subtotal** | | | | **$8,000,000** <---------- |
| | **PROJECT TOTAL** | | | | **#########** |

| | | |
|---|---|---|
| **Conceptual Cost Range - Lower Bound (percent of Project Total)** | **70%** | **$32,400,000** |
| **Conceptual Cost Range - Upper Bound (percent of Project Total)** | **130%** | **$60,200,000** |

**Scope Accuracy:**
**Level 1:** Project scope well understood and well defined.
**Level 2:** Project scope conceptual. Scope lacks detail due to significant unknown operational or project conditions, permit requirements, and limited knowledge of e
**Level 3:** Project scope is a "vision" with limited detail.

**Engineering Effort:**
**Level A:** Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining.) Project Development & Construction Contingencies ranges between 10%-20%.
**Level B:** Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.
**Level C:** Little or no engineering performed. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

# CONCEPTUAL BUDGET ESTIMATE - SSFL RAIL SITE 2B - *Including Optional Tracks*

Location: **Santa Susana, approx MP 440, SCRRA Ventura County Subdivision**
Project Name: **Santa Susana Field Laboratory Rail Logistics Study**
**Site 2B - *THIS ESTIMATE INCLUDES OPTIONAL TRACKS***

By: RailPros
Date orig: August 19, 2015
Revision#:
Date:

**THIS ESTIMATE HAS A RATING OF:** ***2C*** *(See rating scale guide below.)*

**Scope:** **Santa Susana Field Laboratory Rail Logistics Study**
Conceptual cost estimate for Site 2B with ***4*** Loading Tracks. Totals include costs for ***both*** gondola and ABC/container

**Assumptions** See report.

**CONSTRUCTION**

| ITEM DESCRIPTION | EST. QUANT. | UNITS | UNIT PRICE | EXTENDED COST |
|---|---|---|---|---|
| Mobilization | 1 | PCT | 8% | $ 1,689,686.06 |
| Bonds and Insurance | 1 | PCT | 2% | $ 422,421.52 |
| *Rail* | | | | |
| Railroad Flagging | 50 | Day | $ 1,200 | $ 60,000 |
| Trackwork | 10,700 | TF | $ 270 | $ 2,889,000 |
| Turnouts | 5 | EA | $ 120,000 | $ 600,000 |
| Railroad subballast | 10,700 | CY | $ 55 | $ 588,500 |
| Tie-In at SCRRA Connection | 1 | LS | $ 100,000 | $ 100,000 |
| Railroad Signaling | 1 | LS | $ 500,000 | $ 500,000 |
| | | | *rail subtotal* | *$ 4,737,500* |
| *Sitework and Structures* | | | | |
| Clearing and Grubbing | 11.9 | AC | $ 8,000 | $ 95,354 |
| Earthwork (assumed 2' cuts and fills across paved area+retaining wa | 24,741 | CY | $ 30 | $ 742,222 |
| Retaining Wall (adjacent to buildings/movie set location. Assume 5' | 1,000 | LF | $ 600 | $ 600,000 |
| Railroad Bridge PCCB (adjacent to stormwater facilities) | 120 | TF | $ 6,000 | $ 720,000 |
| Culvert Extensions | 1 | EA | $ 20,000 | $ 20,000 |
| Roadway Entrance (driveway approach, signage, guard shack, etc) | 1 | EA | $ 50,000 | $ 50,000 |
| Perimeter Security Fencing (Chain Link) | 9,300 | LF | $ 15 | $ 139,500 |
| Site Power | 1 | LS | $ 150,000 | $ 150,000 |
| Site Lighting | 1 | LS | $ 1,000,000 | $ 1,000,000 |
| Stormwater Conveyance | 1 | LS | $ 500,000 | $ 500,000 |
| Stormwater Treatment Facilities | 1 | LS | $ 1,500,000 | $ 1,500,000 |
| Water Connection | 1 | LS | $ 50,000 | $ 50,000 |
| Sewer Connection | 1 | LS | $ 150,000 | $ 150,000 |
| Utility Relocation (eg, fiber optic in SCRRA ROW, unkonwn utilities) | 1 | LS | $ 400,000 | $ 400,000 |
| Temporary Office/Job Shack | 1 | EA | $ 50,000 | $ 50,000 |
| Reconstruct/Relocate Existing Storwater Structures | 1 | LS | $ 2,000,000 | $ 2,000,000 |
| | | | *sitework subtotal* | *$ 8,167,076* |
| *Roadway Associated with Container Operation* | | | | |
| Paving/Hot Mix Asphalt (*average* depth: 9") | 16,200 | Ton | $ 95 | $ 1,539,000 |
| Aggregate Base Course (average uniform depth under HMA: 12") | 19,500 | Ton | $ 35 | $ 682,500 |
| Heavy-Duty Conc. Curb and Gutter (HMA perimeter) | 5,800 | LF | $ 25 | $ 145,000 |
| Misc. Striping and Signing | 1 | LS | $ 100,000 | $ 100,000 |
| Truck Scale (Above Ground, New) | 1 | EA | $ 100,000 | $ 100,000 |
| | | | *roadway/container subtotal* | *$ 2,566,500* |
| *Conveyor Associated with Gondola Operation* | | | | |
| Conveyor (elevated, enclosed galleries, 36" wide belt, max 1000 TP | 250 | LF | $ 2,000 | $ 500,000 |
| Surge Bin (500 ton cap'y) | 1 | EA | $ 150,000 | $ 150,000 |
| Loading Shed with Dust Control | 1 | EA | $ 2,500,000 | $ 2,500,000 |
| | | | *conveyor subtotal* | *$ 3,150,000* |
| *Restoration* | | | | |
| Site Cleanup and Restoration at End of Project | 1 | LS | $ 2,500,000 | $ 2,500,000 |
| | | | *construction subtotal* | *$ 23,233,183* |
| **Construction Subtotal** | | | | **$23,300,000** |
| Property/ ROW Acquisition | 11.9 | AC | $ 150,000.00 | **$1,787,879** |
| **Right of Way Subtotal** | | | | **$1,800,000** |
| **Construction + ROW Subtotal (Construction + Property Acquisition)** | | | | **$25,100,000** |

# CONCEPTUAL BUDGET ESTIMATE - SSFL RAIL SITE 2B - *Including Optional Tracks*

Location: **Santa Susana, approx MP 440, SCRRA Ventura County Subdivision** — By: RailPros
Project Name: **Santa Susana Field Laboratory Rail Logistics Study** — Date orig: August 19, 2015
**Site 2B - *THIS ESTIMATE INCLUDES OPTIONAL TRACKS*** — Revision#:
Date:

**THIS ESTIMATE HAS A RATING OF:** ***2C*** *(See rating scale guide below.)*

**Scope:** **Santa Susana Field Laboratory Rail Logistics Study**
Conceptual cost estimate for Site 2B with ***4*** Loading Tracks. Totals include costs for ***both*** gondola and ABC/container

**Assumptions** See report.

| | | | | | |
|---|---|---|---|---|---|
| **SITE MOBILE EQUIPMENT** | | | | | |
| | Site Mobile Equipment | | | | |
| | Rubber Tired Gantry, Diesel Powered, New (for each pair of loading | 2 | EA | $ 750,000 | $ 1,500,000.00 |
| | Container Yard/Chassis Hostler Truck, New | 1 | EA | $ 45,000 | $ 45,000.00 |
| | Railcar Mover, New (only required for gondolas; UPRR switches ABC | 1 | EA | $ 200,000 | $ 200,000.00 |
| | | | | *subtotal* | *$ 1,745,000.00* |
| | **Mobile Equipment Subtotal** | | | | **$1,800,000** |
| | **Capital Cost Contingencies (*Applied to All Cost Items, Incl. Property + Equipment)*** | | 35% | | **$ 9,415,000** |
| | **Capital Cost Subtotal #########** | | | | <---------- |

| | | | | |
|---|---|---|---|---|
| **PROJECT DEVELOPMENT & SUPPORT** | | | | |
| Local Permits (% of Construction Subtotal + related Contingency) | | 3% | | $ 940,000 |
| Ventura County/SCRRA ROW Lease | LS | | | $ 80,000 |
| Project Management (% of Capital Cost Subtotal) | | 3% | | $ 1,090,000 |
| Environmental Documentation (NEPA/CEQA) (% of Const. Subtot. + related C | | 5% | | $ 1,570,000 |
| PS&E, Operations Planning (Site & Rail) (% of Const. Subtot.+ related Contin | | 8% | | $ 2,520,000 |
| Railroad Coordination (% of Construction Subtotal + related Contingency) | | 0.25% | | $ 80,000 |
| Construction Management (% of Construction Subtotal + related Contingency) | | 7% | | $ 2,200,000 |
| | | | *subtotal* | $ 8,480,000 |

**Project Development Subtotal $8,480,000** <----------

**PROJECT TOTAL #########**

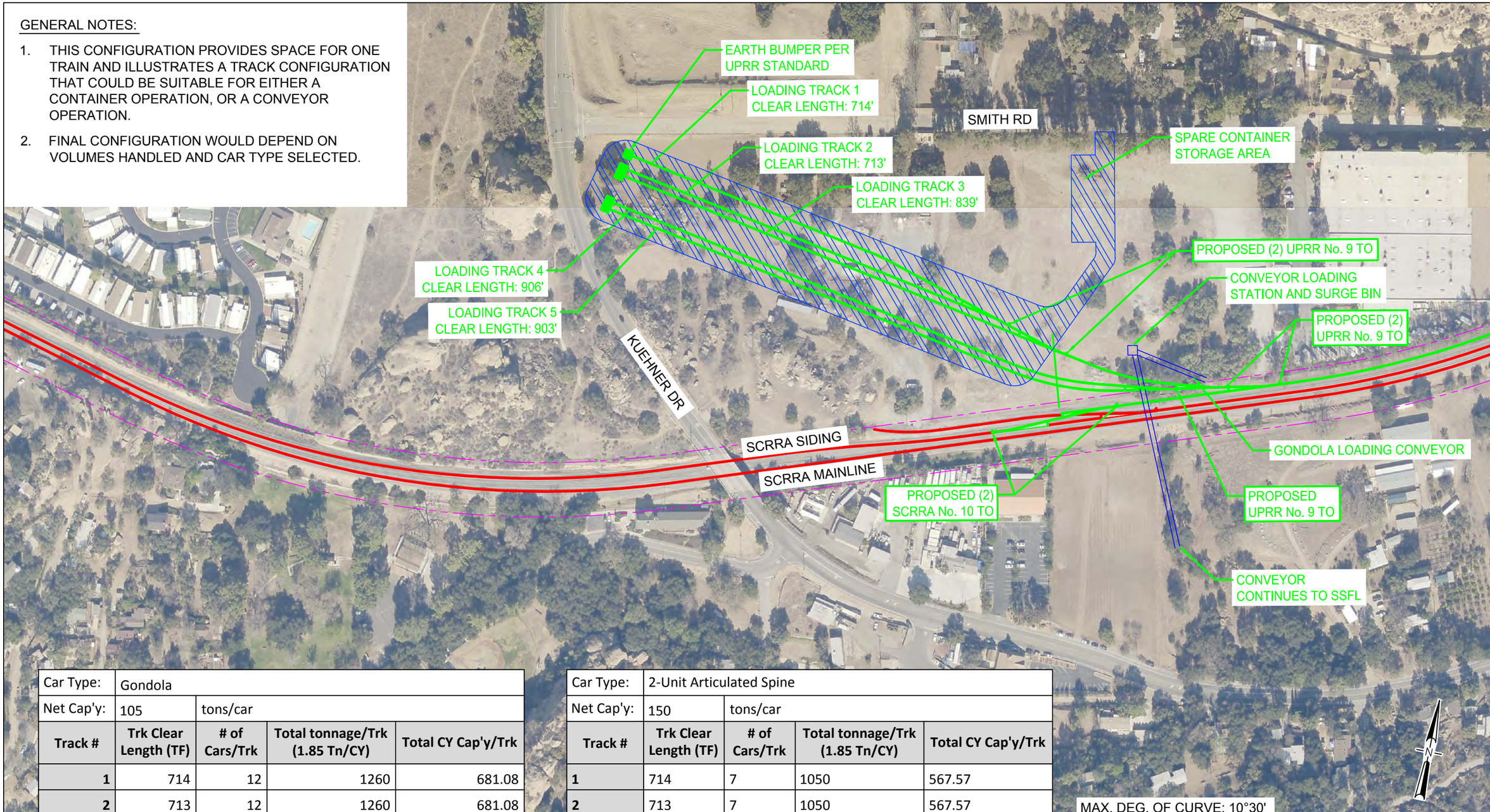
| | | |
|---|---|---|
| **Conceptual Cost Range - Lower Bound (percent of Project Total)** | **70%** | **$31,400,000** |
| **Conceptual Cost Range - Upper Bound (percent of Project Total)** | **130%** | **$58,200,000** |

**Scope Accuracy:**
**Level 1:** Project scope well understood and well defined.
**Level 2:** Project scope conceptual. Scope lacks detail due to significant unknown operational or project conditions, permit requirements, and limited knowledge of e
**Level 3:** Project scope is a "vision" with limited detail.

**Engineering Effort:**
**Level A:** Preliminary engineering performed. Technical information is available, engineering calculations have been performed; clear understanding of the materials size and quantities needed to execute job. Schedule understood; staff and permitting is fairly clear, (however this element may still need refining.) Project Development & Construction Contingencies ranges between 10%-20%.
**Level B:** Conceptual engineering performed. Technical information is available, rough engineering calculations may have been performed, or similar information from previous similar work is compared and used. Project Development Contingencies ranges between 15% to 25% and Construction Contingencies ranges between 20% to 30%.
**Level C:** Little or no engineering performed. Limited technical information available and/or analysis performed. Project Development and Construction Contingencies should be selected appropriately by Project Manager. Contingency may range up to 50%.

GENERAL NOTES:

1. THIS CONFIGURATION PROVIDES SPACE FOR ONE TRAIN AND ILLUSTRATES A TRACK CONFIGURATION THAT COULD BE SUITABLE FOR EITHER A CONTAINER OPERATION, OR A CONVEYOR OPERATION.
2. FINAL CONFIGURATION WOULD DEPEND ON VOLUMES HANDLED AND CAR TYPE SELECTED.




| Car Type: | Gondola | | | |
|---|---|---|---|---|
| Net Cap'y: | 105 | tons/car | | |
| **Track #** | **Trk Clear Length (TF)** | **# of Cars/Trk** | **Total tonnage/Trk (1.85 Tn/CY)** | **Total CY Cap'y/Trk** |
| **1** | 714 | 12 | 1260 | 681.08 |
| **2** | 713 | 12 | 1260 | 681.08 |
| **3** | 839 | 14 | 1470 | 794.59 |
| **4** | 906 | 16 | 1680 | 908.11 |
| **5** | 903 | 15 | 1575 | 851.35 |
| Total Capacity: | | | | 3916.22 |

| Car Type: | 2-Unit Articulated Spine | | | |
|---|---|---|---|---|
| Net Cap'y: | 150 | tons/car | | |
| **Track #** | **Trk Clear Length (TF)** | **# of Cars/Trk** | **Total tonnage/Trk (1.85 Tn/CY)** | **Total CY Cap'y/Trk** |
| **1** | 714 | 7 | 1050 | 567.57 |
| **2** | 713 | 7 | 1050 | 567.57 |
| **3** | 839 | 8 | 1200 | 648.65 |
| **4** | 906 | 9 | 1350 | 729.73 |
| **5** | 903 | 9 | 1350 | 729.73 |
| Total Capacity: | | | | 3243.24 |

MAX. DEG. OF CURVE: 10°30'

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LEGEND
- Existing Mainline Trackage
- Proposed Base Case Track
- Truck Road
- Railroad Property Line

DRAWN BY: AC
CHECKED BY: BB
DATE: 07/29/2015
SHEET NUMBER 1 OF 2

LOCATION & DESCRIPTION:
SANTA SUSANA FIELD LABRATORY
RAIL SITE 1 CONCEPTUAL LAYOUT
MP 440.3 - 441.1, VENTURA SUB - SCRRA


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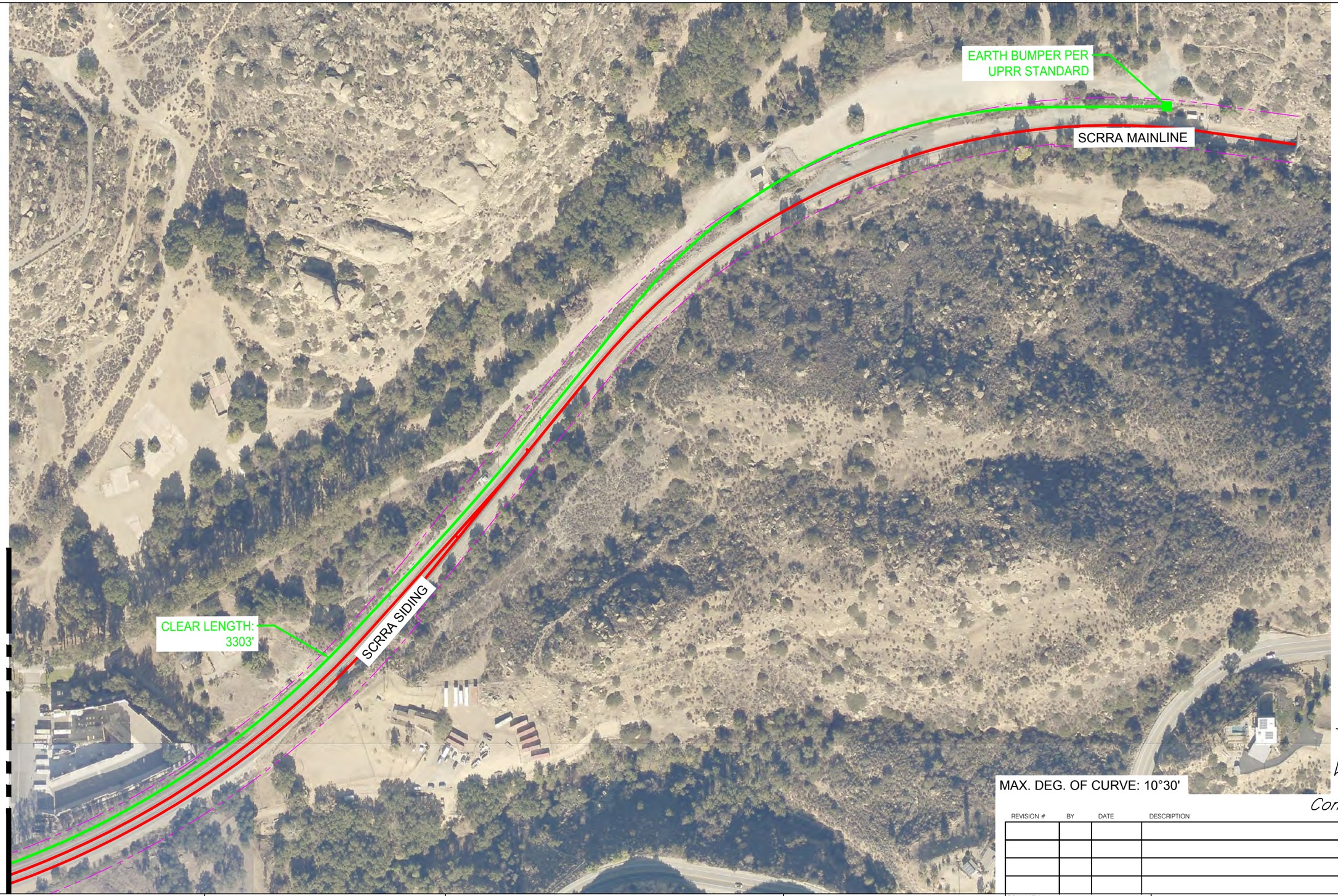


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SCALE IN FEET

LEGEND
- Existing Mainline Trackage
- Proposed Base Case Track
- Truck Road
- Railroad Property Line

DRAWN BY: AC
CHECKED BY: BB
DATE: 07/29/2015
SHEET NUMBER 2 OF 2

LOCATION & DESCRIPTION:
SANTA SUSANA FIELD LABRATORY
RAIL SITE 1 CONCEPTUAL LAYOUT
MP 440.3 - 441.1, VENTURA SUB - SCRRA

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MAX. DEG. OF CURVE: 10°30'

*Concept Design*

| REVISION # | BY | DATE | DESCRIPTION |
|---|---|---|---|
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SCALE IN FEET

LEGEND
- Existing Mainline Trackage
- Proposed Base Case Track
- Optional Expanded Track
- Truck Road
- Optional Expanded Truck Road
- Property R/W or Boundary Line

DRAWN BY: AC
CHECKED BY: BB
DATE: 07/29/2015
SHEET NUMBER 1 OF 2

LOCATION & DESCRIPTION:
SANTA SUSANA FIELD LABRATORY
RAIL SITE 2B CONCEPTUAL LAYOUT
MP 440.3 - 441.1, VENTURA SUB - SCRRA

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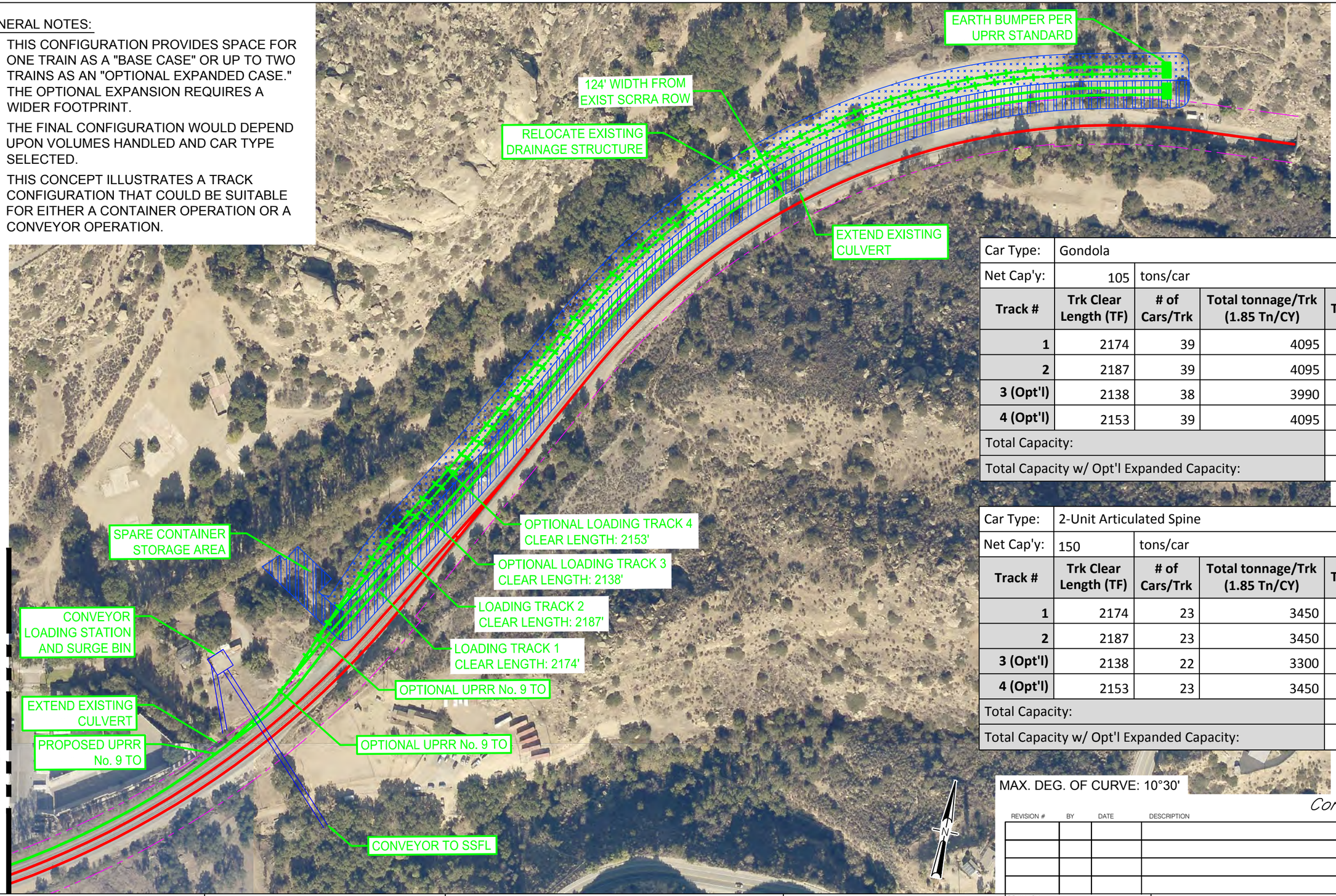
GENERAL NOTES:

1. THIS CONFIGURATION PROVIDES SPACE FOR ONE TRAIN AS A "BASE CASE" OR UP TO TWO TRAINS AS AN "OPTIONAL EXPANDED CASE." THE OPTIONAL EXPANSION REQUIRES A WIDER FOOTPRINT.
2. THE FINAL CONFIGURATION WOULD DEPEND UPON VOLUMES HANDLED AND CAR TYPE SELECTED.
3. THIS CONCEPT ILLUSTRATES A TRACK CONFIGURATION THAT COULD BE SUITABLE FOR EITHER A CONTAINER OPERATION OR A CONVEYOR OPERATION.




| Car Type: | Gondola | | | |
|---|---|---|---|---|
| Net Cap'y: | 105 | tons/car | | |
| **Track #** | **Trk Clear Length (TF)** | **# of Cars/Trk** | **Total tonnage/Trk (1.85 Tn/CY)** | **Total CY Cap'y/Trk** |
| **1** | 2174 | 39 | 4095 | 2213.51 |
| **2** | 2187 | 39 | 4095 | 2213.51 |
| **3 (Opt'l)** | 2138 | 38 | 3990 | 2156.76 |
| **4 (Opt'l)** | 2153 | 39 | 4095 | 2213.51 |
| Total Capacity: | | | | 4427.03 |
| Total Capacity w/ Opt'l Expanded Capacity: | | | | 8797.30 |

| Car Type: | 2-Unit Articulated Spine | | | |
|---|---|---|---|---|
| Net Cap'y: | 150 | tons/car | | |
| **Track #** | **Trk Clear Length (TF)** | **# of Cars/Trk** | **Total tonnage/Trk (1.85 Tn/CY)** | **Total CY Cap'y/Trk** |
| **1** | 2174 | 23 | 3450 | 1864.86 |
| **2** | 2187 | 23 | 3450 | 1864.86 |
| **3 (Opt'l)** | 2138 | 22 | 3300 | 1783.78 |
| **4 (Opt'l)** | 2153 | 23 | 3450 | 1864.86 |
| Total Capacity: | | | | 3729.73 |
| Total Capacity w/ Opt'l Expanded Capacity: | | | | 7378.38 |

MAX. DEG. OF CURVE: 10°30'

*Concept Design*

| REVISION # | BY | DATE | DESCRIPTION |
|---|---|---|---|
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SCALE IN FEET

LEGEND
- Existing Mainline Trackage
- Proposed Base Case Track
- Optional Expanded Track
- Truck Road
- Optional Expanded Truck Road
- Property R/W or Boundary Line

DRAWN BY: AC
CHECKED BY: BB
DATE: 07/29/2015
SHEET NUMBER 2 OF 2

LOCATION & DESCRIPTION:
SANTA SUSANA FIELD LABRATORY
RAIL SITE 2B CONCEPTUAL LAYOUT
MP 440.3 - 441.1, VENTURA SUB - SCRRA


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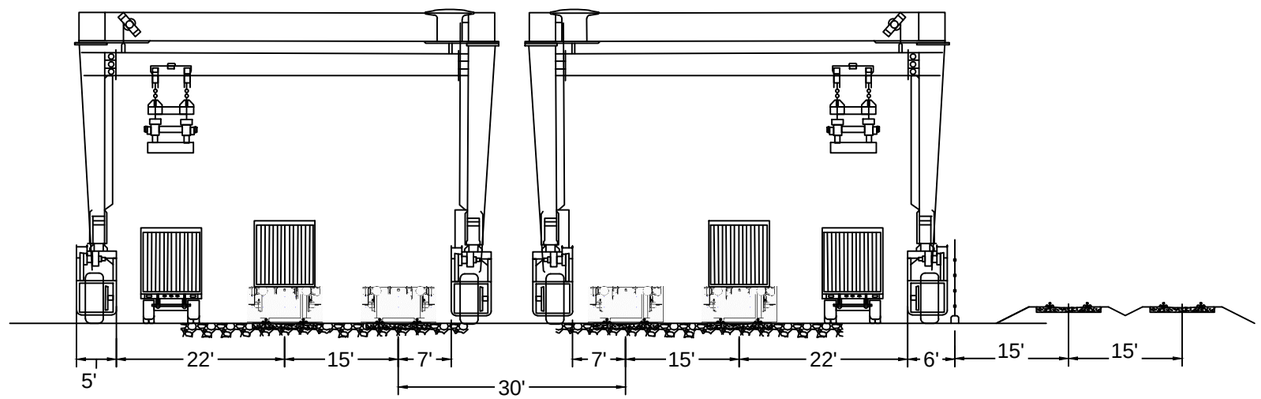


EXPANDED CAPACITY OPTION

ADDS 2 TRACKS + ADDITIONAL TRUCK LANE + ADDITIONAL 1 CRANEWAY

EXPANDED CAPACITY: 57' WIDE

BASE OPTION

2 TRACKS + TRUCK LANE + 1 CRANEWAY

BASE OPTION: 55' WIDE

TYPICAL SECTION WITH OPTIONAL EXPANDED CAPACITY

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# KOA Santa Susana Soil Transport Feasibility Study Pipe Conveyors

One Source

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| Project Name: | Santa Susana Soil Transport Feasibility Study - Pipe Conveyors |
| Study No.: | FLS5627-31JUL15 Rev. 1 |
| Reference: | KOA Corporation |
| Submittal Date: | 9 October 2015 |

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### Approvals

| Date | Manager | |
|---|---|---|
| 2015.10.9 | David Holland | Original issue |
| 2015.10.9 | David Holland | Rev. 1 |

### Revision Log

| Date | Revision | Responsible | Description |
|---|---|---|---|
| 2015.10.9 | 0 | Lynn Petersen<br>Steve Svatek | Original issue |
| 2015.10.9 | 1 | Steve Svatek<br>Lynn Petersen | Addition of Edison Road route (SCER) and extended NACR route evaluations; updated specifications, assumptions, and costs |

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## Abbreviations and Definitions

| Abbreviation | Definition | Abbreviation | Definition |
|---|---|---|---|
| $ | United States Dollar | lbs/ft3 | Pounds per Cubic Foot |
| BCY | Bank Cubic Yard | M (m) | Meter |
| C | Centigrade | m/sec | Meter per Second |
| CAPEX | Capital Expenditure | m3 | Cubic Meter |
| F | Fahrenheit | mm | Millimeter |
| FASL | Feet Above Sea Level | mph | Miles per Hour |
| FLS | FLSmidth USA, Inc. | mt | Metric Tonne |
| Ft (ft) | Feet | mtph | Metric Tonnes per Hour |
| ft/sec | Feet per Second | NACR | North American Cutoff Road |
| HP (hp) | Horsepower | op | Operation |
| hr | Hour | OPEX | Operating Expenditure |
| hr/yr | Hours per Year | SCER | Edison Road Route |
| in | inch | SSFL | Santa Susana Field Laboratory |
| kg/m3 | Kilograms Per Cubic Meter | tpa | Tons per Annum |
| KOA | KOA Corporation | tph | Tons per Hour |
| kW | Kilowatt | VFD | Variable Frequency Drive |
| KWh | Kilowatt Hour | $yd^3$ | Cubic Yards |
| lbs | Pounds | yr | Year |

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# Section 1 Introduction

## 1.1 Addendum #1 and Report Revision

The initial study report submitted on August 7, 2015 focused on finding suitable routes where pipe conveyors could follow existing roads to various load out sites. Truck Site 1 was not identified as a potential load out area at that time. After submitting the initial report, FLSmidth (FLS) was authorized under Addendum #1 to also evaluate the Edison Road (SCER) route with a termination point at Truck Site 1. KOA Corporation (KOA) also asked FLS to estimate the cost of extending the North American Cutoff Road (NACR) route conveyor to two alternative rail sites near Rail Site 2A on the north side of the railroad tracks.

This revised report (Rev. 1) supersedes the August 7, 2015 submitted report. Information has been included on the SCER route and NSCR route alternative rail sites. This report also addresses KOA and ESA comments about the initial report. Additionally, some equipment specifications, assumptions, and cost information have been updated in this report based on new information obtained since the issuing of the original report.

## 1.2 Background

The Santa Susana Field Laboratory (SSFL) is located in a 2,600 acre area in the hillside area of Simi Valley, California, near the crest of the Simi Hills at the western border of the San Fernando Valley. Beginning in the 1940's, the SSFL site was used mainly for research, development, and testing of nuclear reactor technology, and liquid propellant rocket engines. Operations, testing, disposal, and accidents have left the site with contaminated soils, for which the California Department of Toxic Substances Control (DTSC) is leading a study for cleanup, transportation, and disposal alternatives.

DTSC is the lead regulatory agency overseeing the investigation and cleanup of contaminated soil and groundwater at the SSFL. Multiple state, federal and local government agencies also play a role in the cleanup under way at the SSFL site. The DTSC requested a study to evaluate available solutions so that they and the responsible parties of Boeing, the Department of Energy, and NASA will be able to develop the best transport methods and routes for site soil remediation activities.

Previous studies and reviews by CH2M Hill, NASA, and KOA have identified and recommended several potential conveying methods and routes. In April 2015 FLS was contacted by KOA to comment on previous study's recommendations for the use of alternative conveying methods. After reviewing the reports, FLS observed that a pipe conveyor might also be an attractive alternative for this application and suggested that the projects' study be expanded to include this option.

KOA has commissioned this study with FLS to examine at a high level the potential, practicability, and cost of a pipe conveyor option for this application.

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### 1.3 Study Deliverables

The deliverables for this study are as follows:

- The battery limits of the pipe conveyor supply
- A nominal route for the conveyor
- A profile of the conveyor over this route
- Description of the conventional vs pipe conveyor technology as it applies to this application and location
- An indication of the structural support for the pipe conveyor over this route
- Capacity of the pipe to meet transfer requirements
- A description of the loading and unloading methodology of the pipe conveyor
- Commentary of dust emission controls or considerations
- Budgetary CAPEX estimate for the pipe conveyor
- Indicative OPEX costs
- Project timeline

### 1.4 Summary of Key Findings

The following are the key findings of the study:

- Pipe conveyors can provide a valuable material handling solution for projects where the terrain is difficult, transfer points are undesirable, environmental factors benefit from complete enclosure, or existing infrastructure eliminates the potential use of conventional conveyors.
- Pipe conveyors have the ability to transfer in two directions either sequentially or simultaneously while minimizing capital investment. This is a byproduct of the design of the system not available by any other transport technology.
- A 16,732 ft long, 500 tph capacity pipe conveyor design that originates at the SSFL, broadly follows the North American Cutoff road, and terminates at Rail Site 2A was developed. This conveyor rests mostly on the road grade and is elevated over the terrain (60% of its length) where it cannot negotiate sharp turns in the road, or when it crosses roads, creeks, wildlife crossings, and other obstacles.

  The estimated installed cost of this conveyor plus allocations for required infeed and outfeed equipment that was not part of this study is approximately $33,768,000, or $22.81 /BCY ($18.77 /ton) for the 1.48 million BCY of material conveyed during the eight (8) year project term. Total capital and operating costs over the eight year operating period is $29.71 /BCY ($24.46 /ton).

  Estimates were also made to extend the North American Cutoff Road route to alternate rail loading sites 2A North and Alt 2A North located on the north side of the railroad tracks near Rail Site 2A.

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The estimated installed cost for Rail Site 2A North is $34,755,000, or $23.47 /BCY ($19.32 /ton). Total capital and operating costs over the eight year operating period is $30.59 /BCY ($25.18 /ton).

The estimated installed cost for Rail Site Alt 2A North is $37,672,000, or $25.44 /BCY ($20.94 /ton). Total capital and operating costs over the eight year operating period is $33.19 /BCY ($27.31 /ton).

- A 17,060 ft long, 500 tph capacity pipe conveyor design that originates at the SSFL, broadly follows the Edison road, and terminates at Truck Site 1 was developed. This conveyor rests mostly on the road grade and is elevated over the terrain (75% of its length) where it cannot negotiate sharp turns in the road, or when it crosses roads, creeks, wildlife crossings, and other obstacles.

  The estimated installed cost of this conveyor plus allocations for required infeed and outfeed equipment that was not part of this study is approximately $37,510,000, or $25.34 /BCY ($20.85 /ton) for the 1.48 million BCY of material conveyed during the eight (8) year project term. Total capital and operating costs over the eight year operating period is $32.84 /BCY ($27.03 /ton).

- Based on the information and data provided, and the review of economic analysis, a pipe conveyor provides an attractive solution for the Santa Susana soil remediation project.

  The North American Cutoff Road and Edison Road routes are both viable options because they:
  - Follow a nearly continuous existing roadway from the loading point to the preferred loadout sites
  - Avoids major industrial and residential areas
  - Corridor vertical inclinations are within pipe conveyor capabilities

  However, the North American Cutoff Road route conveyor system does offer some advantages over the Edison Road Route conveyor system:
  - Slightly lower cost
  - Less variable route terrain allowing for the conveyor to follow the existing roadway more closely resulting in lower terrain disruption and easier installation
  - Less existing roadway upgrade required
  - Rail loading sites offer option for loading both railcars and trucks
  - Close proximity alternative rail loading sites are available

- To develop the solution further, a more detailed engineering study is required. Details regarding topography, the required conveyor loading and discharge systems, interfaces, and the requirement for-two way conveying are among those areas requiring greater examination.
- It is recommended that further study be completed.

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### 1.5 FLSmidth Qualification

Pipe conveyors of many different designs and sizes have been installed for mining and dry bulk port material handling operations throughout the world. FLSmidth is a leading supplier of this technology, having provided more than 380 pipe conveyors, but competes with many other OEM's.

The data and estimates provided by FLSmidth are based on a combination of actual performance data and FLSmidth's best technical judgment. Prices and costs presented in this report are FLSmidth's best estimates based on the information presented are subject to change with the introduction of new information or requirements.

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# Section 2 Scope of Study

## 2.1 Scope of Work

FLS's scope of work includes the following:

- Overview of pipe conveyor basics
- Recommended pipe conveyor route based on comparison analysis of identified potential conveyor routes
- Profile of recommended pipe conveyor route
- Pipe conveyor specifications, and support requirements and considerations
- Pipe conveyor loading and unloading requirements and considerations
- General considerations for maintenance, access, security, and control systems
- General considerations for contaminated material handling and safety, dust control, noise abatement, and other environmental considerations
- General considerations for conveying replacement material back uphill to site
- Estimated capital cost (CAPEX)
- Estimated annual operating costs (OPEX)
- Project timeline
- General comparison of recommended pipe conveyor to previous studies' recommended conveyance methods

## 2.2 Key Assumptions and Clarifications

FLS's key assumptions and clarifications pertinent to completing this study include:

- No radiological waste will be used on the conveyor as the total volume would likely be removed while the conveyor is being permitted and constructed. Therefore, only non-radioactive material will be conveyed by the conveyor system.
- Approximately 1,500,000 bank cubic yards (BCY) of contaminated soil are to be removed from the site by conveyor over an eight (8) year project term.
- Maximum lump size of 4.0 inches.
- Operation of the conveyor is limited by the excavation rate of 735 BCY/day, or approximately 62 tons per hour. A minimum conveyor capacity of 300 tph was used in the FLS conveyor design system design based on earlier information.
- The design capacity of the pipe conveyor is determined by pipe diameter and belt speed. The capacity of the pipe conveyor that FLS has designed can be varied between 100 – 500 tph by varying the belt speed with the included motor VFD controls.

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- The preferred loadout sites along the rail corridor are assumed to be Rail Site 2A and Site 2B.
- The preferred loadout site for the Edson Road route is assumed to be Truck Site 1.
- Rights and permits for construction and operations are readily obtainable for potential conveyor routes.

### 2.2.1 Exclusions and Study Limits

For purposes of clarification, the following items are considered outside of this study scope and are excluded from this proposal:

- Geotechnical engineering, reports, and studies: Site surveying and measurements, verification of topography or geotechnical data (for construction or design purposes), the use of the soils, the structural suitability of the soils, the processes for placing and compacting the soils, and the inspection of the construction effort are all part of the geotechnical requirements are to be prepared by others.
- Civil works: Civil design, all civil and bulk/mass earthworks, and all concrete, foundations, anchor bolts, and their associated engineering are excluded. An allocation for concrete footers and foundations has been included in CAPEX estimates, but these are highly subjective and dependent upon unknown geotechnical specifications.
- Permits: Every permit and license that may be required to undertake the scope of this project.
- Infeed and loadout facilities and equipment: Infeed and loadout facilities are not part of the cost scope of this study although a typical provision for them is included in estimating the total cost of a pipe conveyor system. Actual cost of infeed and loadout equipment and facilities is dependent upon complete material specifications and better defined objectives and operational specifications for the conveyor system.
- Electrical supply and installation: A medium voltage power feed is required to be provided at either the head or tail end of the conveyor. No provisions have been made concerning the availability and installation of electrical distribution substations or transformers.

## 2.3 Study Methodology

The following methodology and process steps were followed in making the pipe conveyor recommendation and pricing in this study:

- Review of study's objectives and deliverables.
- Review of project's assumptions and sensitivities.
- Review of previous studies' reports and recommendations.
- Determine selection criteria for comparing possible pipe conveyor corridors based on pipe conveyor strengths and weaknesses, and the project's objectives and sensitivities.
- Identify potential pipeline routes.

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- Based on pipe conveyor corridor selection criteria, evaluate each identified corridor and select the recommended route(s).
- Perform a preliminary design and pricing of a pipe conveyor for chosen route(s).

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# Section 3 Pipe Conveyor Basics

## 3.1 Introduction

Pipe conveyors can provide a valuable material handling solution for projects where the terrain is difficult, transfer points are undesirable, environmental factors benefit from complete enclosure, or existing infrastructure eliminates the potential use of conventional conveyors. Pipe conveyors can also convey material in two directions, which can be a benefit in certain situations. They can handle steeper grades and sharper turns, with horizontal, vertical and compound conveyor curves. While a non-elevated pipe conveyor is generally more expensive than a trough conveyor of similar length, extended elevated sections, reduced civil works, and the elimination of transfer towers can often bring the overall installed cost to a similar level.

## 3.2 Pipe Conveyor General Description

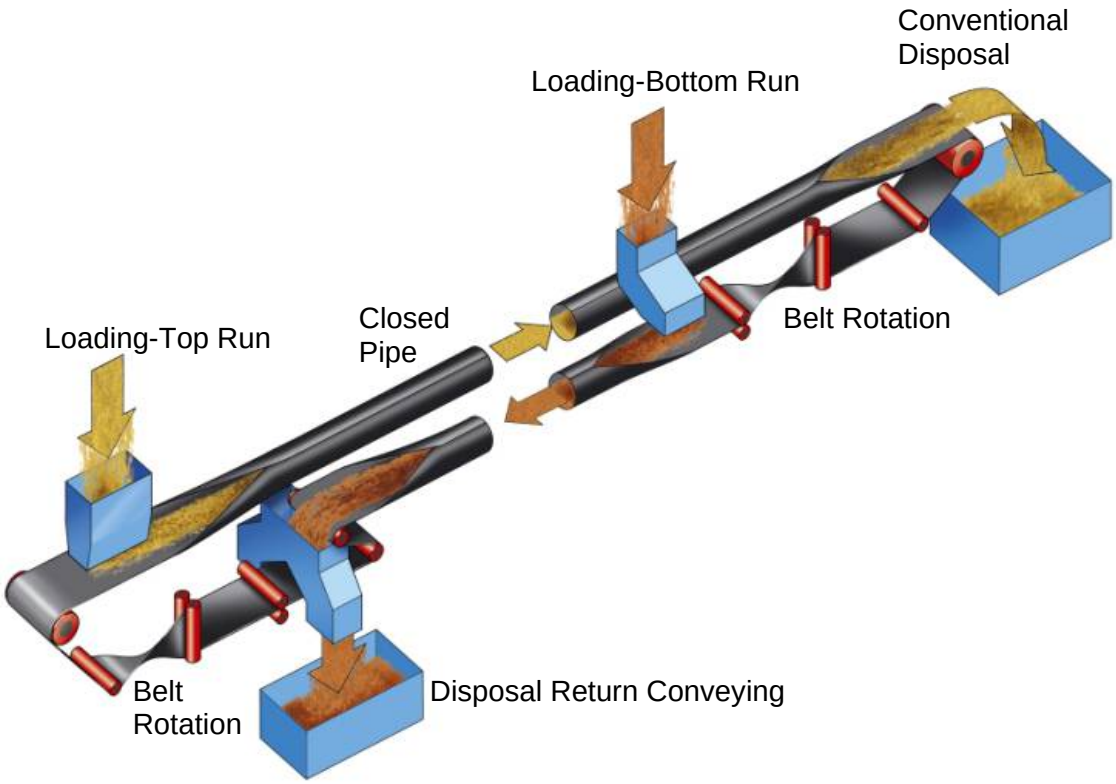


**Figure 3-1: Pipe conveyor operation overview**

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In the material loading area, the pipe conveyor belt is open and is loaded in a similar fashion to a conventional conveyor belt. After loading, a special idler arrangement forces the flat belt to be rolled up and closed into a conveyor pipe that then carries the conveyed material.

At the discharge point, the belt reopens to discharge the material. After discharge, the return belt automatically closes again to form a closed pipe, but allows the option for additional material loading. The belts ability to open and close allows simultaneous material transport in the conveyor's upper run and its lower return belt run, as shown below.

The belt pipe is flexible, which allows for directional changes without requiring transfer stations. It can follow natural and manmade routes, such as hills, rivers, bridges, roads, etc. Routing can be at grade, on bends, or with horizontal, vertical, or even three-dimensional curves. Depending on the routing and belt size, the pipe conveyor typically has electric drive motors at the tail as well as head pulleys. All drive motors are frequency controlled to achieve different handling speeds.

### 3.3 Material Loading

In the material loading area, the pipe conveyor belt is open and is loaded like a conventional conveyor belt. After loading, a special idler arrangement forces the flat belt to be rolled up and closed into a pipeline that then carries the conveyed material. During transport, the belt forms a sealed pipe, which protects the material to be transported from outside influences such as wind and rain.

Properly sized material and a constant feed rate are important for pipe conveyors to function properly. Depending upon the type of material being handled, typical product sizing equipment may include grizzly or screens, crushers, rotary breakers, or low speed sizers. A belt feeder is typically used to meter the material onto the pipe conveyor belt at a constant rate.

**Figure 3-2: Pipe conveyor closing**

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### 3.4 Material Discharge

The pipe conveyor can be opened (flatten) to discharge material at any point along its length, if planned in advance. At the discharge point, the pipe conveyor is automatically unrolled and opened through special idler arrangement. The material discharge is the same as for a conventional belt conveyor.

After material discharge, the return belt automatically closes again, to form a completely enclosed sealed pipe. Therefore, there is no spillage of material in the lower strand making the conveyor more suitable for environmentally sensitive applications as compared to conventional open belt conveyors or trucks.

**Figure 3-3: Pipe conveyor discharging**

### 3.5 Pipe Conveyor Components

Each pipe conveyor generally includes the following features:

- Conveyor drives including electric motor, gear reducer, high- and low-speed couplings, drive bases, and safety guards, and backstop.
- Pulley assemblies including shafts, bearings and pillow blocks, hold-down bolts, tail guards, and pulley lagging protection plates.
- Impact, carrying, return, transition, training, and pipe idlers, including brackets, frames, and noise-cancelling damping elements at pipe rollers.
- Conveyor belting, including belt splice kits.
- Primary and secondary belt scrapers at head pulleys.
- Belt plows at tail pulley and return belt side before tail drive or take-up systems.
- Belt tensioning take-up and tower.
- Discharge chute with stiffeners and liner, where necessary.
- Skirtboards with stainless steel liners, cover, and rubber seals.
- Safety switches.
- Conveyor frame structures at charging and discharging stations.
- Cover hoods at the charging station, where the belt is open.
- Cladding and cover hoods at the discharge station, where the belt is open.
- Top covers along the remaining segments of the pipe conveyor.
- Pulleys frames for the pipe run of the conveyor.

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- Elevated pipe bridges with walkway (trusses, typically spaced 80 – 100 ft where necessary.
- Light pipe panels on bottom.
- Protective mesh panels along the pipe conveyor.
- Guards for drives, tail pulleys, and rotating parts.

### 3.6 Advantages

Pipe conveyor technology offers many specific advantages for Santa Susana soil transport:

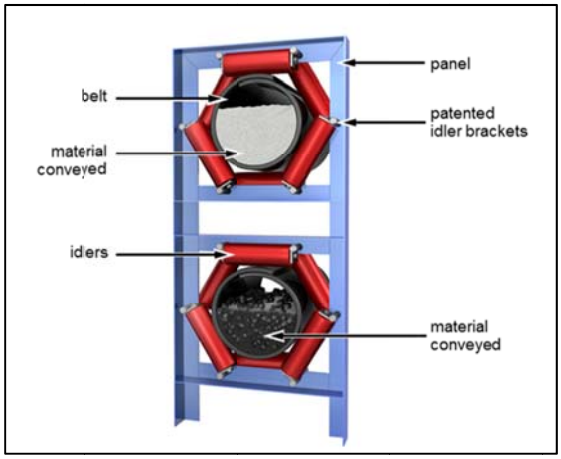


**Figure 3-4: Pipe conveyor idler configuration**

- **Dust suppression and environmental protection:** As the pipe conveyor is a fully enclosed transportation system, the pipe completely encloses the contaminated material. Dust cannot escape and no material spillage can occur. This greatly helps to eliminate dust, internal and external material contamination, rainfall penetration, and the potential for injury. Furthermore, pipe conveyors are noted for their relatively low noise emission.
- **Higher carrying angle:** Unlike conventional conveyors, where the upper limit for carrier belts normally would not exceed 17 degrees, pipe conveyors can transport material at up to 28 degrees of positive or negative inclination. This is an important consideration when locating conveyors on steep or undulating topography.
- **Two-way conveying:** The pipe conveyor has the unique capability of conveying material in both directions either simultaneously or separately.
- **Multiple discharge points:** The pipe conveyor design permits easy access for any number of discharge points along the conveyor's length. This feature allows for different materials to be conveyed by the same conveyor and to store them in separate piles.
- **Safety:** By mounting the conveyor on concrete sleepers or pylons along the conveyor route at a nominal 8 ft, with mechanical barriers at each pylon, the system allows ready access to the conveyor for maintenance purposes, while

**Figure 3-5: Pipe conveyor support system**

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virtually eliminating the potential for injury. The pipe conveyor structure may also be completely enclosed by protective mesh and a roof covering for guarding when installed at ground level.

- **Far fewer foundations:** When the pipe conveyor design requires elevated sections, the sections can be mounted on pylons up to 130 ft apart, depending on load and structural design of the conveyor frame. This provides significant opportunity to work with existing topography, reduces foundational requirements, and minimizes costs associated with civil works.
- **Flexibility:** The pipe conveyor's flexible belt-pipe design readily accommodates long distance transport by allowing for changes in direction without requiring transfer stations. This flexibility overcomes terrain undulations and easily follows natural routes such as hills, rivers, bridges, buildings, roads, etc. Routing can be at grade, on bends, or with horizontal, vertical, or even three-dimensional curves.
- **Resistance to high winds:** The pipe conveyor's construction allows it to withstand strong winds and cyclonic conditions (up to 120 mph) without additional design considerations.
- **Maintenance access:** When constructed using triangular tubular pipe in an elevated installation, a unique feature of the pipe conveyor's design is that it allows the use of a motorized maintenance vehicle. This vehicle straddles the conveyor structure. It is designed to provide an efficient method for conveyor inspection and repair personnel to gain access to conveyor components along the entire length of the conveyor, which eliminates the need for walkways on either side of the conveyor.

**Figure 3-6: Pipe conveyor elevated box truss support system**

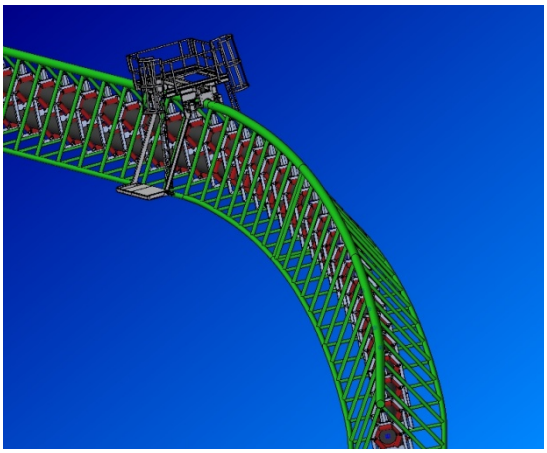

**Figure 3-7: Pipe conveyor maintenance trolley system**

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# Section 4 Pipe Conveyor Route Selection and Recommendation

## 4.1 Introduction

The study focused on finding suitable routes where pipe conveyors could follow existing roads. There are a number of roads which lead from the cleanup site to the rail corridor. The Runkle Haul Road, Edison Road, and Arness Fire Road exit the site from the eastern side. These were initially eliminated from consideration because of their distance from the conveyor loading area at the SSFL and the fact that they ended in primarily residential or industrial areas. The Edison Road route (SCER) was later evaluated at the request of KOA. Two other roads, Black Canyon Road and North American Cutoff Road exit on the area's west side. These two roads are well positioned for the SSFL collection location and were chosen as the routes to further evaluate.

## 4.2 Pipe Conveyor Route Selection Criteria

The following factors were important in conveyor corridor routing:

- Avoid residential areas, wherever possible
- Minimize impact to undisturbed lands
- Reduce transfer points to eliminate the potential for dust and spillage issues
- Allow easy removal and cleanup of the system components once the project is complete
- Broadly follow existing roads to enhance system assess, reduce installation costs, and reduce disruption to the natural environment

## 4.3 Review of Previous Studies' Reports and Recommendations

Previous studies by CH2M Hill, NASA, and KOA identified potential loading zones located along the rail corridor to handle and prepare the contaminated material for continuing on rail and/or truck transport. As an alternative to trucking this material to these loading zones, potential conveyor routes were identified for trough and aerial cable conveyors.

Although trucking the material was determined to be the least cost method, other considerations make this form of transport less desirable. Rail Site 2A and a modified North American Cutoff Road (NACR) route were viewed as the most feasible truck route and load out site.

Conveying systems in general are deemed a practical solution. However, each type of conveyor system has its unique advantages and disadvantages, particularly as they relate to their level of natural resources protection and cost.

Figure 4-1 shows the routes identified in the previous KOA study.

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**Figure 4-1: Previous study recommended conveyor and road corridors**

## 4.4 Pipe Conveyor Option

Trough belt and aerial conveyors both require substantial natural terrain disturbance for corridors and foundations. However, in addition to their low noise, dust, and spillage advantages, pipe conveyors have the unique ability, within limits, to follow steep terrain and curving corridors. This ability allows pipe conveyors the option to follow exiting roadways keeping the amount of natural terrain disruption to a minimum. Following existing roadways also minimizes site preparation and installation costs, and allows for easy access for installation, maintenance, and removal of the system.

## 4.5 Identification of Potential Pipe Conveyor Routes

Google Earth was used as the primary mapping tool to identify and plan potential pipe conveyor routes. Because of its accuracy limitations, Google Earth surfaces should only be considered approximate. However, for purposes of this study this level of accuracy is acceptable. Future more detailed studies should be based on topographical maps and surveyed GPS positions.

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Abiding by the premise that following existing roadways and keeping the conveyor length as short as possible will minimize total installation costs, two potential pipe conveyor routes were identified; Black Canyon Road route, and the North American Cutoff Road (NACR) route. The Edison Road Route (SCER) was also evaluated after this report was initially submitted.

### 4.6 Black Canyon Road Conveyor Route

The Black Canyon Road has a shortest length distance of the routes considered. It is also believed by FLS that a pipe conveyor route could be installed primarily along the existing road reducing the amount of required elevated sections. However, on further analysis the Black Canyon Road route option was discarded because of the following reasons:

- The Black Canyon Road route discharges at Rail Site 4 in an industrial area. This rail site is not as favorably viewed as Rail Site 2A.
- The conveyor route could not easily avoid and would go through residential housing areas.

### 4.7 North American Cutoff Road Route

The North American Cutoff Road route (NACR) was quickly identified as the preferred pipe conveyor route. Figure 4-2 shows the plan view of the conveyor route and cross section of the terrain. Please note that the following figures with the route's location may not always show the conveyor on the roadway. The intension is for the conveyor to follow the roadway as much as possible.

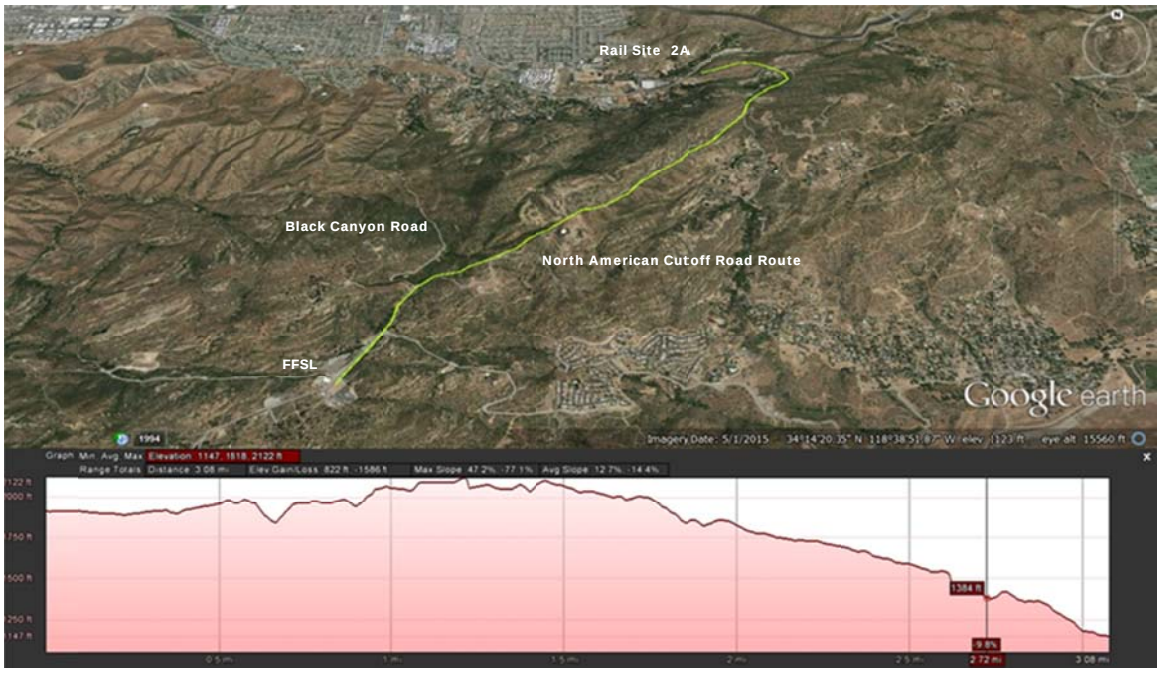


**Figure 4-2: North American Cutoff road route**

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This route was chosen because:

- Terminates at Rail Site 2A
- The route has a nearly continuous exiting roadway from the loading point to loadout site reducing the amount of required corridor civil works and elevated conveyor sections
- Relatively short conveying distance
- Avoids major industrial and residential areas
- Corridor vertical inclinations are within pipe conveyor capabilities

This route begins east of Burro Flats and ends at Rail Site 2A, for an approximate overall length of 16,732 ft. In general, the route begins at 1,912 FASL and is flat or slightly uphill until it reaches the uppermost section of elevation. This section is approximately 1,000 ft long and begins at 6,600 ft from the tail of the conveyor. The elevation averages 2,080 FASL and varies +/- 20 ft. The conveyor then declines steadily until it reaches the final discharge elevation of 1,150 FASL. From beginning to end, the conveyor was designed with an 800 ft maximum loss of elevation.

### 4.8 North American Cutoff Road Route - Initial Section

The initial 165 ft length of conveyor is required for material loading and to fully enclose the pipe at the tail end of the conveyor. Once enclosed, the pipe conveyor route follows along the western side of the Facility Road until it reaches the intersection of Black Canyon Road and the NACR. The conveyor crosses over the Black Canyon Road on elevated structure and then continues along the northern side of the NACR. Shortly after the road crossing, a series of sharp turns in the NACR (50 – 200 ft radius turns) force the pipe conveyor to cross two small valleys with support structures positioned downslope of the road. The conveyor returns back to road grade for a short distance once past this section. The NACR width varies from single to dual lane width and client may wish to upgrade portions to allow better conveyor alignment or easier installation and maintenance.

**Figure 4-3: North American Cutoff road route initial section**

Figure 4-3 shows the beginning section of the conveyor route.

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### 4.9 North American Cutoff Road Route - Middle Section

The pipe conveyor route leaves the road grade in two more sections where the road curve radius is greater than the design radius of the pipe conveyor. Similar to the first section, elevated structure is used to cross two smaller ravines prior to reaching the upper grade section.

**Figure 4-4: North American Cutoff road route middle section**

Once the upper elevation section is reached, the pipe conveyor crosses over the NACR and primarily continues along the south side of the road. Whenever the conveyor route must leave the road grade, the conveyor is supported on elevated structure.

Figure 4-4 shows the middle section of the conveyor route.

### 4.10 North American Cutoff Road Route - Lower Section

The final section of the road continues along the south side of the NACR until the paved Box Canyon Road is reached. The conveyor crosses over the NACR, a private road and the Santa Susana Pass Road, all on elevated structure.

Once across the Santa Susana Pass Road, the conveyor declines rapidly across previously undisturbed land and terminates at Rail Site 2A. Figure 4-5 shows the final section of the conveyor route.

**Figure 4-5: North American Cutoff road route lower section**

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In total, approximately 60% of the pipe conveyor length (10,000 ft) is supported on elevated structures with a minimum clearance of 20 ft. No attempt was made to fine tune this conceptual design due to the limited accuracy of Google Earth and the objective of this study being for proof of concept only. However, FLS believes that after a proper survey of the surrounding topography, the conveyor route could be modified to more closely align with the existing roadway resulting in a reduction in the estimated cost.

### 4.11 North American Cutoff Road Route – Alternate Rail Loading Sites

KOA requested that FLS also estimate the cost of extending the NACR route conveyor to two alternative rail loading sites near Rail Site 2A on the north side of the railroad tracks. These are designated as sites Rail Site 2A North and Rail Site Alt 2A North on Figure 4-6.

**Figure 4-6: North American Cutoff Road Route Alternative Rail Sites**

Moving the discharge of the pipe conveyor from Rail Site 2A to Rail Site 2A North will require adding approximately 400 ft to the length of conveyor, and the addition of a railroad crossover.

Moving the discharge of the pipe conveyor from Rail Site 2A to Rail Site Alt 2A North will require adding approximately 2,520 ft to the length of conveyor, and the addition of a railroad crossover. The additional cost of conveying to these alternative loading sites is covered in *Section 6 Pipe Conveyor Estimated Costs*.

The proposed modified conveyor routes are shown by the blue line for Rail Site 2A North, and the lavender line for Rail Site Alt 2A North on Figure 4-6.

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### 4.12 Edison Road Route

Figure 4-7 shows the Edison Road route (SCER) starting on the left (west) side of the SSFL, and the North American Cutoff Road route (NACR) starting on the right (east) side.

**Figure 4-7: North American Cutoff Road Route and Edison Road Route (SCER)**

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### 4.13 Edison Road Route – General Description

Figure 4-8 shows the plan view of the conveyor route and cross section of the terrain. The

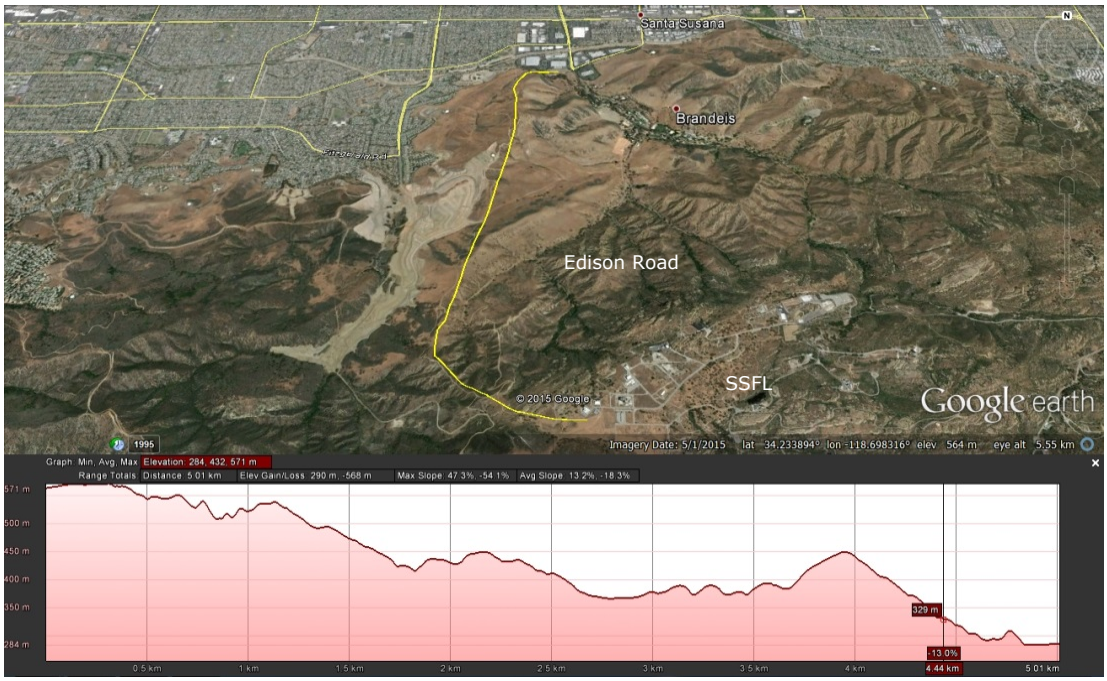


**Figure 4-8: Edison Road Route profile**

intention is for the conveyor to follow the roadway as much as possible, but some deviations are necessary due to terrain and sharpness of curves.

This route was chosen because:

- Terminates at Truck Site 1
- Offers one of the most direct and shortest conveying paths
- A roadway exists for much of the route
- Corridor vertical inclinations are within pipe conveyor capabilities

The route begins west of Burro Flats and ends at Truck Site 1. This route has an overall length of 17,060 ft and is nearly the same length as the NACR.

The route begins at 1,848 FASL and is flat or slightly uphill until it reaches its highest elevation 1,873 FASL, approximately 1,025 ft from the loading point. The conveyor then declines steadily until it reaches the final discharge elevation of 1,150 FASL. From beginning to end, the conveyor was designed with a 910 ft loss of elevation.

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### 4.14 Edison Road Route - Initial Section

The initial 165 ft length of conveyor is required for material loading and to fully enclose the pipe at the tail end of the conveyor. Once enclosed, the pipe conveyor route follows along the northern side of the SCER route until the road turns to the north. The conveyor then heads north, following the ridgeline along the eastern side of the SCER route. The SCER road is generally a single lane width with multiple curves that exceeds the pipe conveyor bending radius. The client may wish to upgrade portions to allow better conveyor alignment or easier installation and maintenance.

**Figure 4-9: Edison Road Route initial section**

Figure 4-9 shows the beginning section of the conveyor route.

### 4.15 Edison Road Route - Middle Section

The pipe conveyor route is located east of the SCE road and has to leave the road grade in a numerous sections, as the road curve radius is greater than the design radius of the pipe conveyor. Similar to the first section, elevated structure is used where needed to cross ravines, roads or whenever the conveyor must leave the road grade.

**Figure 4-10: Edison Road Route middle section**

There is new residential construction occurring along the west side of

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the pipe conveyor route and special consideration needs to be made concerning this.

Figure 4-10 shows the middle section of the conveyor route.

### 4.16 Edison Road Route - Lower Section

The final section of the road continues along the ridgeline east of the SCER and then declines and turns to the east until Truck Site 1 is reached.

Figure 4-11 shows the final section of the conveyor route.

**Figure 4-11: Edison Road Route lower section**

Because the roadway in this route has more sharp curves and difficult terrain than the NACR route, approximately 75% of the pipe conveyor length (12,800 ft) is supported on elevated structures with a minimum clearance of 20 ft. Similar to the first route, no attempt was made to fine tune this conceptual design due to the limited accuracy of Google Earth and the objective of this study being for proof of concept only. However, FLS believes that after a proper survey of the surrounding topography, the conveyor route could be modified to more closely align with the existing roadway resulting in a reduction in the estimated cost.

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# Section 5 Pipe Conveyor Design Criteria and Specifications

## 5.1 Site Conditions

The SSFL site is at a higher physical altitude than surrounding open lands, neighborhoods, and rail corridor. There are steep grades that must be considered in planning new roadways and conveyor routes. The site is in an arid area with limited rainfall and vegetation typical to an arid region. Base ground material rocky of unknown composition.

## 5.2 Material Properties and Operating Characteristics

FLS has completed preliminary equipment sizing and designs based on the material characteristics and operational requirements listed in table 5-1. However, many material characteristics are unknown and need to be defined for future more detailed studies.

**Table 5-1: Material and Operating Characteristics**

| Item | Value |
|---|---|
| Material | Contaminated Soil |
| Bulk density (volume) | 80 - 100 lbs/ft$^3$ (1,281 – 1,602 kg/m$^3$) |
| Bulk density (driving power calculation) | 80 lbs/ft$^3$ (1,281 kg/m$^3$) |
| Conveyor route inclination | +10 / -15 degrees |
| Angle of repose | TBD |
| Surcharge angle | TBD |
| Elevation | < 2,150 FASL |
| Temperature range | 32 - 104 °F (0 °C – 40 °C) |

## 5.3 Pipe Conveyor Design Considerations and Specifications

The propose pipe conveyor system design has been based around the following considerations:

- Inexpensive as practical to meet requirements
- Minimized installation costs
- Minimized disassemble cost
- Elimination of transfer points
- Reusable or resalable components and materials to maximum salvage value

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### 5.4 Pipe Conveyor Curve Radius

Based on belt size and type, for layout purpose, the minimum curve radius of the pipe conveyor is 787 ft in both the horizontal and vertical axis. This radius needs to be verified during the engineering phase. FLS generally recommends a physical examination of the proposed route by a pipe conveyor expert to validate the proposed pipe conveyor layout. It should be noted that several sections of the NACR and SCER routes includes turns that are sharper than the pipe conveyor can negotiate. In these instances either the conveyor will have to be routed to bypass the curve, or the roadway will need to be regraded to accommodate the pipe conveyor. For the purposes of this study we have assumed that the roadway path cannot be changed and the conveyor route will bypass the sharp curves.

Table 5-2 shows the available bending radius for steel cable belting for a pipe conveyor size selected for Santa Susana soil remediation consideration.

**Table 5-2: Minimum Pipe Conveyor Bend Radius for 11.8 in (300 mm) Pipe Diameter**

| Curve Angle (deg) | Recommended Minimum Bend Radius (Steel Belting) | Minimum Bend Radius |
|---|---|---|
| < 25 | 700 x Pipe Diameter | 689 ft (210 m) |
| 25 to 50 | 800 x Pipe Diameter | 787 ft (240 m) |
| 50 to 75 | 900 x Pipe Diameter | 886 ft (270 m) |
| 75 to 100 | 1,000 x Pipe Diameter | 984 ft (300 m) |

### 5.5 Pipe Conveyor Design Assumptions and Specifications

Conveying volumes, capacities, and years of operation are based on KOA and ESA comments to the initial report.

The diameter of the pipe conveyor, and consequentially the 500 tph design conveyor capacity, is partially driven by the maximum lump size that the conveyor must be able to convey. A smaller diameter pipe conveyor and resulting lower capacity is possible if the maximum lump size requirement is reduced. It may be necessary to install more crushing equipment (additional capital) at the conveyor loading area to achieve this. A tradeoff study between the cost of providing a smaller maximum lump size and the cost of a larger diameter pipe conveyor to accommodate a larger lump size should be made to determine the most economic pipe conveyor diameter that meets the maximum capacity requirements. However, for this application, a 7” – 9” diameter pipe conveyor may be the smallest practical size. Pipe diameter size and cost are not linearly related and a smaller diameter pipe may only realize a 15% – 20% in capital savings.

Tables 5-3 and 5-4 summarize the key design assumptions used for the design of the proposed pipe conveyors for the NACR and SCER routes.

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**Table 5-3: Pipe Conveyor Design Assumptions**

| Item | Value |
|---|---|
| Total Volume to Convey *(non-radioactive only)* | 1,480,000 BCY (1,131,541 $m^3$) |
| Total Weight to Convey | 1,798,868 ton (1,631,905 tonne) |
| Years of Operation | 8 Years |
| Operation Hours (50 hr/wk, 50 wk/yr) | 3,024 hr/yr |
| Minimum Required Conveyor Capacity | 74 tph (67 mtph) |
| Design Capacity | 500 tph (454 mtph) |
| Maximum / Average Lump Size | 4 in (100 mm) / 3 in (76 mm) |
| Take-up Location / Type | Head / Horizontal Gravity |
| Minimum Conveyor Turn Radius (vertical and horizontal axis) | 787 ft (240 m) |
| Conveyor Inclination (Max / Min) | +10 degree / -15 degree |
| Conveyor system will discharge onto a pile or into a storage bin that will further be loaded onto trucks or into railcars | |

**Table 5-4: Pipe Conveyor Design Specifications**

| Item | NACR Route Rail Site 2A | NACR Route Rail Site 2A North | NACR Route Rail Site Alt 2A North | SCER Route Truck Site 1 |
|---|---|---|---|---|
| Length | 16,732 ft (5,100 m) | 17,132 ft (5,222 m) | 19,252 ft (5,868 m) | 17,060 ft (5,200 m) |
| Net Lift | -800 ft (-244 m) | -808 ft (-246 m) | -860 ft (-262 m) | -910 ft (-277 m) |
| Pipe Conveyor Diameter | 12 in (300 mm) | 12 in (300 mm) | 12 in (300 mm) | 12 in (300 mm) |
| Belt Width | 43 in (1,100 mm) | 43 in (1,100 mm) | 43 in (1,100 mm) | 43 in (1,100 mm) |
| Belt Type | ST2500 Steel Core | ST2500 Steel Core | ST2500 Steel Core | ST2500 Steel Core |
| Belt Speed[1] | 9.8 ft/sec (3.0 m/sec) | 9.8 ft/sec (3.0 m/sec) | 9.8 ft/sec (3.0 m/sec) | 9.8 ft/sec (3.0 m/sec) |
| Belt Fill[1] | 40% | 40% | 40% | 40% |

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| Item | NACR Route Rail Site 2A | | NACR Route Rail Site 2A North | | NACR Route Rail Site Alt 2A North | | SCER Route Truck Site 1 | |
|---|---|---|---|---|---|---|---|---|
| Power Requirement *(full load 500 tph)* | Installed[2] Hp | Running Hp | Installed[2] Hp | Running Hp | Installed[2] Hp | Running Hp | Installed[2] Hp | Running Hp |
| Downhill only | 2,816 | 2,146 | 2,890 | 2,210 | 3,240 | 2,470 | 3,000 | 2,300 |
| Uphill only | 2,816 | 2,414 | - | - | - | - | - | - |
| Combined | 3,621 | 3,513 | - | - | - | - | - | - |

[1] *The 12 inch pipe diameter used has more capacity than used. The capacity of the pipe conveyor can be increased by increasing the fill percentage or conveyor speed. A corresponding increase in power will be required.*

[2] *Three standardized motors; two located at head drive, one at tail drive.*

### 5.5.1 Conveyor Support and Elevated Truss Sections

Fabricated panels hold the idlers in place with the panels integrated into a lattice girder spaced up to 130 ft apart. Connection girders between the panels give the structure stability. When the conveyor is located at ground level and on flat terrain, the panels are directly mounted on concrete sleepers resting on the ground surface approximately every 8 ft.

For elevated conveyor sections over road crossings, creeks, wildlife crossings, and other hazards, the panels are mounted in fabricated trusses supported on pylons. Truss elements are assembled on the ground to simplify installation and lifted into place. Elevated sections provide a smooth conveying transition both horizontally and vertically between ground-mounted conveyor sections at a minimum required height. Elevated truss sections provide a minimum 20 ft clearance over road crossings. A standard elevated truss section includes a walkway on one side.

In the current designs it is estimated that approximately 60% and 75% of the conveyor's length will be composed of elevated sections. Although indeterminate until a site survey is completed, the amount of elevated structure will likely be substantially reduced in the final design when a more accurate road-following conveyor path can be defined.

*An allocation for concrete footers and foundations has been included in CAPEX estimates, but these are highly subjective and dependent upon unknown geotechnical specifications.*

### 5.5.2 Take-Up

The pipe conveyor system is assumed to be a gravity belt take-up system at the head (downhill) end which automatically maintains the proper level of tension on the belt and the load on the conveyor changes.

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### 5.5.3 Drive System

Conveyor drives consists of an electric motor and reducing gearbox combination designed for use in this instance with medium AC voltage. Motor speed is controlled by a Variable Frequency drive (VFD) for each motor. Gearbox reducers with internal backstops are attached between each motor and pulley driveshafts. An external braking system is also included to help slow the conveyor during stops and to maintain a consistent speed as necessary when conveying downhill.

Two drives at the head (downhill) end and one drive at the tail (uphill) end are used in the proposed design.

### 5.5.4 Idlers

Pipe conveyor idlers are used in each of the following three areas:

- Pipe forming area: Three-part troughed idler stations
- Belt closing and opening areas: Adjustable idler stations in the
- Closed pipe area: Panels with 12 carrying idlers in each

All carrying idlers are lifetime greased, provided with multiple labyrinth sealing, and powder coating to reduce required maintenance.

### 5.5.5 Belt Cleaners

The pipe conveyor includes one primary and one secondary belt cleaner at the downhill head pulley of the conveyor to assure proper cleaning of the belt after discharging the material. Although normally sufficiently effective, a belt washing and drying station is also an option if belt cleaners do not adequately clean the belt.

### 5.5.6 Conveyor Infeed

The conveyor infeed system is not included in the scope of this study and its design has not been included. However, the infeed must feed material onto the pipe conveyor at the proper size and consistent volume rate. To achieve this, the infeed system will need to include the following:

- Hopper or bin to receive the material hauled by other equipment
- Sizing or rotary feeder breaker to reduce the material size to a maximum of 4 inches
- Screening to ensure that only selected material is delivered into the pipe conveyor. Foreign materials i.e. oversized rock and debris such as discarded piping or metal objects etc. need to be removed.
- Belt feeder to meter the material onto the belt at a constant rate
- Dust control may also be required to minimize potential environmental issues

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Since an infeed system is required for the proper operation of the pipe conveyor, a typical capital allocation has been included for it in the CAPEX section.

### 5.5.7 Conveyor Discharge

The conveyor discharge is not included in the scope of this study and its design has not been included. However, it is anticipated that the pipe conveyor will discharge into a surge bin that will feed a rail car loading system or stacking system.

Different types of contaminated soil can be stored separately, as the pipe conveyor provides the ability to easily discharge over different surge bins or stockpiles by opening the belt over these locations.

The discharge system must provide the following minimum equipment:

- Hopper or bin to receive the material from the pipe conveyor
- Belt feeder to meter the material from surge bin into loading unit
- A dust control system if necessary

No design details for the discharge system have been included; however, a capital allocation has been included for it in the CAPEX section.

### 5.5.8 Conveyor Operation Controls

The standard pipe conveyor design incorporates the use of automatic controls to monitor its safe and efficient operation. These automated controls either warn the operator of impending problems, or stop the system in the event of an emergency or critical situation.

Simple system Start/Stop control stations are located at both the loading and discharging ends of the conveyor where operators can monitor conveyor key performance parameters, or manually start and stop the system. Additionally, an emergency stop pull cable system is installed along the conveyor allowing for emergency stopping from any location along the conveyor.

### 5.5.9 Safety Instruments

Pipe conveyors include the following standard safety devices:

- Zero speed sensors
- Pull cord switches and cables
- Belt alignment, slip, tilt and limit switches
- Mechanical belt rip detection
- Horn and light stack
- Conveyor lighting

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- Safety panels with overload switch
- Guards for drives, tail pulleys, and rotating parts

### 5.5.10 Conveyor Security

Integrated protective mesh panels on both sides of the conveyor along the entire conveyor length is proposed to keep debris, wildlife, and the public from contact with the internal workings of the conveyor. These panels are removed to perform maintenance on the conveyor.

Since the conveyor would be located along the side of roads where possible, the use of concrete road barriers is proposed to protect the conveyor from vehicular damage.

### 5.5.11 Two-way Conveying Considerations

The pipe conveyor has the capability to convey material in both directions (two-way conveying). However, the decision to also use the conveyor to transport replacement material back uphill needs to be made prior to the start of conveyor design so that the necessary design changes to allow for this are included. Both ends of the conveyer need to be significantly modified to allow room for both loading and unloading of the belt. The base design and estimated pricing for the proposed pipe conveyor in this study does not include the cost for conveyor end modifications to allow two-conveying.

**Figure 5-1: Two-way conveyor loading and discharging structure**

Figure 5.1 shows a typical pipe conveyor structure required for both loading and discharging.

### 5.5.12 Conveyor Maintenance

Conveyor maintenance typically requires one person and a service truck for each operating shift to inspect, perform regular conveyor clean-up, make minor repairs, and to address or reset any alarms/trips that may occur from the various safety instruments.

Two persons are typically required for preventative maintenance on the down shifts.

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# Section 6 Pipe Conveyor Estimated Costs

This section estimates the associated capital (CAPEX) and annual operation (OPEX) costs for pipe conveyor configurations proposed for the different routes in this study.

## 6.1 Estimated Capital Cost (CAPEX)

Table 6-1 summarizes the estimated capital costs for the different route pipe conveyor configurations defined in this study.

**Table 6-1: Pipe Conveyor Estimated Budget Cost (+/- 25%)[1]**

| Item | Description | NACR Rail Site 2A (US$) | NACR Rail Site 2A North (US$) | NACR Rail Site Alt 2A North (US$) | SCER Truck Site 1 (US$) |
|---|---|---|---|---|---|
| 1 | PC-001 Pipe Conveyor (Φ300 mm) @ 500 stph (455 mtph) | $12,040,000 | $12,200,000 | $13,630,000 | $11,470,000 |
| 2 | Elevated Sections Support Structures[2]<br>*NACR Rail Site 2A: 10,100 ft length*<br>*NACR Rail Site 2A North: 10,500 ft length & RR overpass*<br>*NACR Rail Site Alt 2A North: 11,500 ft length & RR overpass*<br>*SCER: 12,800 ft length* | $2,678,000 | $3,200,000 | $3,492,000 | $3,400,000 |
| 3 | Electrical Controls, Motor VFDs, Switches, Transformer, PLC, etc.[2] | $1,500,000 | $1,500,000 | $1,550,000 | $1,600,000 |
| 4 | Estimated Freight | $750,000 | $755,000 | $800,000 | $765,000 |
| 5 | Estimated Installation and Commissioning | $5,900,000 | $6,100,000 | $6,800,000 | $6,000,000 |
| 6 | Road Improvement[3] / Corridor Preparation *(double lane dirt road, no wall, and off roadway service road)* | $5,000,000 | $5,050,000 | $5,250,000 | $8,500,000 |
| 7 | Conveyor Intrusion Protection Guarding | $400,000 | $400,000 | $450,000 | $275,000 |
| 8 | Concrete Footers and Foundations (Allocation)[4] | $700,000 | $750,000 | $850,000 | $850,000 |

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| Item | Description | NACR Rail Site 2A (US$) | NACR Rail Site 2A North (US$) | NACR Rail Site Alt 2A North (US$) | SCER Truck Site 1 (US$) |
|---|---|---|---|---|---|
| 9 | Concrete Road Barricade (Allocation) | $500,000 | $500,000 | $550,000 | $350,000 |
| 10 | Spare Parts[5] | $300,000 | $300,000 | $300,000 | $300,000 |
| | **Pipe Conveyor Study Scope Subtotal** | **$29,768,000** | **$30,755,000** | **$33,672,000** | **$33,510,000** |
| 11 | Crushing / Feeding Station (Allocation) | $3,500,000 | $3,500,000 | $3,500,000 | $3,500,000 |
| 12 | Discharge Surge Bin (Allocation) | $500,000 | $500,000 | $500,000 | $500,000 |
| | **Pipe Conveyor System Total** | **$33,768,000** | **$34,755,000** | **$37,672,000** | **$37,510,000** |
| 13 | Uphill Conveying of Replacement Material Option[6] | TBD | TBD | TBD | TBD |

[1] *Does not include permits, licenses, taxes or other incidental costs*
[2] *Does not include electrical service to conveyor*
[3] *Includes 2 lane dirt road upgrade from KOA previous study cost estimate*
[4] *Highly subjective and dependent upon unknown geotechnical specifications*
[5] *Estimated at 2% of conveyor capital cost*
[6] *Loadout site details are unknown at this time. Therefore a capital allocation cannot be estimated without more information.*

## 6.2 Estimated Annual Operating Costs (OPEX)

The annual operating cost for a pipe conveyor is estimated on the basis of cost of power, operator and maintenance labor, and repair parts. The estimated operating cost is for operation of the conveyor system only and does not include the costs to feed (excavate and dump material into a loading hopper) the system. The operating cost also assumes that material will discharged onto a pile or storage bin and does not include any additional costs for loading trucks or rail cars.

Table 6-2 summarizes the assumptions used in calculating annual OPEX for the different route pipe conveyor configurations defined in this study.

**Table 6-2: Pipe Conveyor OPEX Assumptions[1]**

| Item | NACR Rail Site 2A | NACR Rail Site 2A North | NACR Rail Site ALT 2A North | SCER Truck Site 1 |
|---|---|---|---|---|
| Annual Conveyor Throughput | 224,859 tpa | 224,859 tpa | 224,859 tpa | 224,859 tpa |
| Conveyor Annual Operating Hours | 3,024 hr/yr | 3,024 hr/yr | 3,024 hr/yr | 3,024 hr/yr |

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| Item | NACR Rail Site 2A | NACR Rail Site 2A North | NACR Rail Site ALT 2A North | SCER Truck Site 1 |
|---|---|---|---|---|
| Pipe Conveyor Equipment Only Cost | $14,718,000 | $15,400,000 | $17,122,000 | $14,870,000 |
| Electricity Cost | $0.08 /kWh | $0.08 /kWh | $0.08 /kWh | $0.08 /kWh |
| Average Running Power | 1,600 kW[1] | 1,648 kW[1] | 1,842 kW[1] | 2,030 kW[1] |
| Operator Loaded Labor Rate | 50.00 $/hr | 50.00 $/hr | 50.00 $/hr | 50.00 $/hr |
| Maintenance Loaded Labor Rate | 50.00 $/hr | 50.00 $/hr | 50.00 $/hr | 50.00 $/hr |
| Number of Operators per Operating Hour | 1 | 1 | 1 | 1 |
| Number of Maintenance People per Operating Hour | 1 | 1 | 1 | 1 |
| Maintenance Parts % of Equipment Cost[2] | 4.0 % | 4.0 % | 4.0 % | 4.0 % |

[1] *Material downhill conveying only*
[2] *Includes spare parts and 2% of capital cost reserve for belt and other major component replacement*

Table 6-3 summarizes estimated annual OPEX for the different route pipe conveyor configurations defined in this study. See Appendix A for calculations and more details.

**Table 6-3: Estimated Annual OPEX[1]**

| Route | Electric Power ($/yr) | Maintenance Parts ($/yr) | Operator Labor ($/yr) | Maintenance Labor ($/yr) | Total ($/yr) |
|---|---|---|---|---|---|
| NACR Rail Site 2A | $387,072 | $588,720 | $151,200 | $151,200 | $1,278,192 |
| NACR Rail Site 2A North | $398,684 | $616,000 | $151,200 | $151,200 | $1,317,084 |
| NACR Rail Site ALT 2A North | $445,617 | $684,880 | $151,200 | $151,200 | $1,432,897 |
| SCER Truck Site 1 | $491,098 | $594,800 | $151,200 | $151,200 | $1,388,298 |

[1] *Material downhill conveying only*

Figure 6-1 shows the estimated annual OPEX for the different route pipe conveyor configurations defined in this study by OPEX cost component.

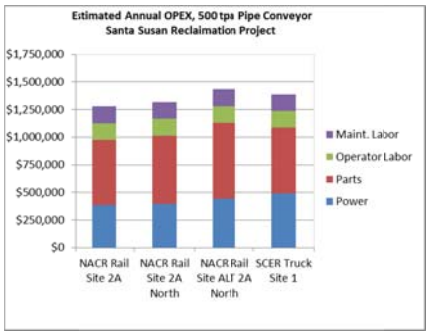


**Figure 6-1: Estimated Annual OPEX**

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Table 6-4 summarizes the estimated annual OPEX for the different route pipe conveyor configurations defined in this study on both material conveyed volume and weight basis. The table also shows the project life's total combined CAPEX and OPEX costs on a bank cubic yard basis. See Appendix A for calculations and more details.

**Table 6-4: Pipe Conveyor Route Estimated Annual Operating Costs (OPEX) and Project Life Costs[1]**

| Route | Total CAPEX ($) | CAPEX ($/BCY) | Equipment Only CAPEX ($) | Annual OPEX ($/yr) | Annual OPEX ($/ton) | Annual OPEX ($/op hr) | Annual OPEX ($/BCY) | Total Project Life - CAPEX & OPEX ($/BCY) |
|---|---|---|---|---|---|---|---|---|
| NACR Rail Site 2A | $33,768,000 | $22.81 | $14,718,000 | $1,278,192 | $5.68 | $422.68 | $6.91 | $29.71 |
| NACR Rail Site 2A North | $34,755,000 | $23.47 | $15,400,000 | $1,317,084 | $5.86 | $435.54 | $7.12 | $30.59 |
| NACR Rail Site ALT 2A North | $37,672,000 | $25.44 | $17,122,000 | $1,432,897 | $6.37 | $473.84 | $7.74 | $33.19 |
| SCER Truck Site 1 | $37,510,000 | $25.34 | $14,870,000 | $1,388,298 | $6.17 | $459.09 | $7.50 | $32.84 |

[1] *Downhill conveying only*

## 6.3 Spare Parts

Based on the relatively low use of 3,024 hr/yr, the short project life, and FLS' experience, spare parts costs for the pipe conveyor are estimated to be approximately 4% of the capital equipment cost over the 8 year project life.

## 6.4 Equipment Salvage Value

Potentially, there is a market for used pipe conveyors that is application dependent. However, the cost of disassembly of the system offsets much of its value. The plan for the conveyor to follow roads reduces the cost of disassembly and the amount of support structure steel which has a lesser value. The motors, drives, and belt can all be sold separately if necessary. The concrete foundation sleepers and concrete road barriers are also reusable. Salvage value depends upon a number of factors including equipment condition, cleanliness, and cost to relocate. However, a typical salvage value for pipe conveyor systems is 10% – 20% of its capital cost.

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### 6.5 Project Timeline

Detailed engineering of this type of pipe conveyor system is typically 4 to 6 months. Based on fabrication times and component availability, the remaining schedule duration for manufacturing, freight, installation, and commissioning is typically 8 to 12 months making at total timeline of 12 to 18 months from ordering to commissioning.

### 6.6 NACR and ESER Routes Comparison

Based on the information and data provided, and the review of economic analysis, a pipe conveyor provides an attractive solution for the Santa Susana soil remediation project.

The North American Cutoff Road and Edison Road routes are both viable options because they:

- Follow a nearly continuous existing roadway from the loading point to the preferred loadout sites
- Avoids major industrial and residential areas
- Corridor vertical inclinations are within pipe conveyor capabilities

However, the North American Cutoff Road route conveyor system does offer some advantages over the Edison Road Route conveyor system:

- Slightly lower cost
- Less variable route terrain allowing for the conveyor to follow the existing roadway more closely resulting in lower terrain disruption and easier installation
- Less existing roadway upgrade required
- Rail loading sites offer option for loading both railcars and trucks
- Close proximity alternative rail loading sites are available

### 6.7 Cost Implications of Extended Project Timeline

Extending the term of the project has little effect on the cost of the system.

The system's capital cost is fixed. It is also designed to last at least 20 years without major replacement, except for possibly the belt, depending upon the amount of use and deterioration over time. A belt replacement reserve has already been included in the annual OPEX parts estimate to cover this cost.

The annual OPEX should remain about the same. OPEX is closely tied to hours of use may drop proportionally due to reduced hours of use. Annual maintenance cost may increase a little as the equipment ages regardless of its hours of use.

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# Section 7 Comparison of Pipe Conveyor to Other Conveyance Methods

The table 7-1 presents a quantitative comparison of pertinent factors for the evaluation of the material transportation alternatives under considered. For each transportation method, the evaluation factors are rated with a value of Low, Medium, or High to indicate whether the solution is desirable, neutral, or less desirable. Each evaluation factor is assigned a factor weight value between 1 and 5 to indicate its relative importance (from less to more) for this project. The rating and factor weight are then used to calculate weighted value for each transportation method which is combined to arrive at an overall score for comparison purposes.

**Table 7-1: Santa Susana Material Transportation Methods Comparison Table**

| Evaluation Factor | Factor Weight[1] | Transportation Method Rating | | | |
|---|---|---|---|---|---|
| | | Truck | Trough Conveyor | Cable Conveyor | Pipe Conveyor |
| Equipment CAPEX | 3 | Low | Medium | High | Medium |
| Equipment OPEX | 3 | High | Low | Medium | Low |
| Access for Maintenance | 2 | Low | Medium | High | Low |
| Noise | 4 | High | Medium | Low | Low |
| Terrain Disruption | 4 | Low | High | Medium | Low |
| Neighborhood Impact | 5 | High | Medium | Medium | Low |
| Installation Difficulty | 2 | Low | High | High | Medium |
| Removal Difficulty | 2 | Low | High | High | Medium |
| 2-Way Conveying Difficulty | 2 | Low | Medium | Low | Low |
| Terrain Footprint | 3 | Low | High | Medium | Medium |
| Visibility to Environment | 3 | Low | Medium | High | Medium |
| Potential for Spills (transfers) | 3 | High | Medium | Medium | Low |
| Capability to Convey Material in Containers[3] | 2 | High | Low | Medium | Low |
| Equipment Salvage Value[3] | 1 | High | Low | Low | Low |
| | **Score[2]** | **87** | **67** | **71** | **98** |

[1] Lower 1 – 5 Higher Priority
[2] Rating Scale: Low, Medium, High; 3, 2, 1 points respectively; Higher score is more favorable
[3] Reversed Rating Scale: Low, Medium, High; 1, 2, 3 points respectively

Based on the evaluation factors, factor weights, and conveyance method ratings shown in the above table, the overall most favorable conveyance method is the pipe conveyor followed by in decreasing favorability, trucking, cable conveyor, and trough conveyor.

The client may have differing opinions as to what factors should be included in the evaluation, the appropriate weight for each factor, and each factor's rating.

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# Appendix A - Budget Estimated Annual Operating Cost (OPEX)

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# Santa Susana - Budget Estimated Annual Operating Cost (OPEX)

*Eight Year Project Term*

10/9/2015

| ASSUMPTIONS | | | |
|---|---|---|---|
| Annual System Production Target (ST): | 224,859 | Operator Labor Rate (US$): | $ 50.00 |
| Density (mt/m$^3$): | 1.28 | Maintenance Labor Rate (US$): | $ 50.00 |
| Net Production Hours (hr/yr): | 3,024 | Electricity Cost (US$/kWh): | $ 0.080 |

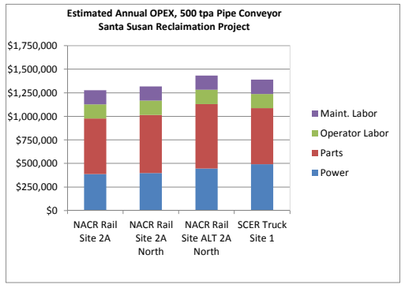
| Route | Quantity | Purchase Year | Description | Material Density (mt/m$^3$) | Capacity mt/hr | Length (m) | Lift (m) | Equipment Unit Cost[1] | Total Equip. CAPEX US$ | Availability (%) | Installed (Nameplate) kW | Demand (Running) kW | % of Total Hrs Operating | Hours Device Used | Elec. Power Cost US$/yr | Maint. Parts % of Capital Cost[2] | Maint. Parts US$/yr | No. Operators /op hr | Operator Labor US$/yr | No. Maint. People /op hr | Maint. Labor US$/yr[3] | Total Maint. Cost US$/yr | OPEX US$/yr | OPEX US$/op hr | OPEX US$/BCY | OPEX US$/ST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NACR Rail Site 2A | 1 | 1 | 500 tph Pipe Conveyor | 1.28 | 500 | 5,100.0 | -244.0 | $14,718,000 | $14,718,000 | 97.0% | 2,100 | 1,600 | 100.00% | 3,024 | $387,072 | 4.0% | $588,720 | 1.00 | $151,200 | 1.00 | $151,200 | $739,920 | $1,278,192 | $422.68 | $6.907 | $5.684 |
| NACR Rail Site 2A North | 1 | 1 | 500 tph Pipe Conveyor | 1.28 | 500 | 5,222.0 | -246.0 | $15,400,000 | $15,400,000 | 97.0% | 2,155 | 1,648 | 100.00% | 3,024 | $398,684 | 4.0% | $616,000 | 1.00 | $151,200 | 1.00 | $151,200 | $767,200 | $1,317,084 | $435.54 | $7.117 | $5.857 |
| NACR Rail Site ALT 2A North | 1 | 1 | 501 tph Pipe Conveyor | 1.28 | 500 | 5,868.0 | -262.0 | $17,122,000 | $17,122,000 | 97.0% | 2,416 | 1,842 | 100.00% | 3,024 | $445,617 | 4.0% | $684,880 | 1.00 | $151,200 | 1.00 | $151,200 | $836,080 | $1,432,897 | $473.84 | $7.743 | $6.372 |
| SCER Truck Site 1 | 1 | 1 | 500 tph Pipe Conveyor | 1.28 | 500 | 5,200.0 | -277.0 | $14,870,000 | $14,870,000 | 97.0% | 2,400 | 2,030 | 100.00% | 3,024 | $491,098 | 4.0% | $594,800 | 1.00 | $151,200 | 1.00 | $151,200 | $746,000 | $1,388,298 | $459.09 | $7.502 | $6.174 |

**Notes:** [1] Equipment only; no freight, installation, or commissioning. Excludes civil works, foundations, and electrical infrastructure

[2] Includes spare parts, and 2% of capital cost reserve for belt and other major component replacement

[3] Includes labor for spare parts replacement only

| | | |
|---|---|---|
| Total Volume To Move: | 1,480,550 | BCY |
| Total Weight To Move: | 1,798,868 | tons |
| **Project Term:** | **8** | **yrs** |
| Bank Bulk Density: | 90 | lb/ft3 |
| Conveying Bulk Density: | 80 | lb/ft3 |
| Op Days | 21 | day/month |
| Op Hours | 12 | hr/day |
| Op Hours | 3,024 | hr/yr |
| Loose Bulk Density: | 1.28 | mt/m3 |
| Single Year Volume Throughput: | 185,069 | BCY/yr |
| Single Year Weight throughput: | 224,859 | st/yr |
| Production Rate: | 734 | BCY/day |
| Production Rate: | 61.20 | BCY/hr |
| Production Rate: | 74.36 | st/hr |




## Pipe Conveyor Total Project Cost - Eight Year Project Term

| Route | Total CAPEX ($) | Total Project Term Volume to Move (BCY) | Total Project Term Weight to Move (ton) | CAPEX ($/BCY) | CAPEX ($/ton) | Equip. Only CAPEX ($) | OPEX ($/yr) | OPEX ($/ton) | OPEX ($/op hr) | OPEX ($/BCY) | Total OPEX Project Term ($) | Total CAPEX & OPEX Project Term ($) | Total CAPEX & OPEX Project Term ($/BCY) | Total CAPEX & OPEX Project Term ($/ton) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NACR Rail Site 2A | $33,768,000 | 1,480,550 | 1,798,868 | $22.81 | $18.77 | $14,718,000 | $1,278,192 | $5.68 | $422.68 | $6.91 | $10,225,536 | $43,993,536 | **$29.71** | **$24.46** |
| NACR Rail Site 2A North | $34,755,000 | 1,480,550 | 1,798,868 | $23.47 | $19.32 | $15,400,000 | $1,317,084 | $5.86 | $435.54 | $7.12 | $10,536,673 | $45,291,673 | **$30.59** | **$25.18** |
| NACR Rail Site ALT 2A North | $37,672,000 | 1,480,550 | 1,798,868 | $25.44 | $20.94 | $17,122,000 | $1,432,897 | $6.37 | $473.84 | $7.74 | $11,463,173 | $49,135,173 | **$33.19** | **$27.31** |
| SCER Truck Site 1 | $37,510,000 | 1,480,550 | 1,798,868 | $25.34 | $20.85 | $14,870,000 | $1,388,298 | $6.17 | $459.09 | $7.50 | $11,106,381 | $48,616,381 | **$32.84** | **$27.03** |