Passive Treatment Solution: The system is designed for longevity (up to 25 years) and projected to have a net alkaline effluent with a 6 to 9 pH and low dissolved metals <1 mg/l iron and aluminum. Each of the components in the system has been successfully installed and monitored on drainage of similar quality and quantity.

Design Flow for System F: 75 gpm

Design Water Quality for System F:

Range in Raw Water Quality from Monitoring Wells
(1998/1Q through 2000/4Q)

pH	Acidity (mg/l)	Dissolved Fe (mg/l)	Dissolved Mn (mg/l)	Dissolved Al (mg/l)
3.7 - 4.7	100 - 500	<0.1 - 32	1.1 - 17	12 - 88

Based on this data, the drainage to be treated by System F is characteristically variable in water quality. To provide optimal treatment capabilities, the "worst case" recorded for each individual parameter from 1998/1Q through 2000/4Q was utilized for design purposes.

Design Water Quality

pH	Acidity (mg/l)	Dissolved Fe (mg/l)	Dissolved Mn (mg/l)	Dissolved Al (mg/l)
3.7	500	32	17	88

Note: The datum listed for each parameter does not represent a single sampling event.

System F Components:

Component	Size	Function
Vertical Flow Pond 1	3,700 tons limestone	generate alkalinity; neutralize acidity
Aerobic Wetland 1	15,000 SF	oxidize & precipitate metals
Vertical Flow Pond 2	1,900 tons limestone	generate alkalinity
Aerobic Wetland 2	7,000 SF	oxidize & precipitate metals
Horizontal Flow Limestone Bed	1,200 tons limestone	generate alkalinity; precipitate manganese
Flush Pond		store sludge from Vertical Flow Ponds

A thin layer (~6 inches) of spent mushroom compost will overlie the limestone aggregate in the Vertical Flow Ponds and will also be used as part of the substrate in the wetlands.

DESIGN NARRATIVE

Water Quality Evaluated

Water monitoring for both surface and groundwater was reviewed to design the proposed system. The available data was used to estimate the probable "worst case" groundwater chemistry to be encountered within this area.

Vertical Flow Ponds

The proposed Vertical Flow Ponds will utilize the dissolution of 90% calcium carbonate equivalent limestone as the primary acid-neutralizing/alkalinity-generating treatment medium. A 4-foot thick layer of AASHTO #1 limestone aggregate will be overlain by a 6-inch layer of Spent Mushroom Compost. Although a reducing environment is encouraged, experience demonstrates that significant iron solids will be retained within the system. Aluminum solids are also retained.

The compost will also provide alkalinity generation through microbial activity; however, the amount of alkalinity that is generated through the sulfate-reducing bacteria will vary based on ambient temperature (less alkalinity generated during colder months). Alkalinity generation by the compost has also been demonstrated to be short lived.

The quantity of limestone to be used within the system is based on the quantity of stone needed to maintain 12 hours of retention within the treatment media throughout the design life plus the amount of limestone that is expected to be "consumed" over the life of the system, in this case up to 25 years.

Due to the elevated level of dissolved metals in the groundwater to be treated, significant retention of metal precipitates is expected within the limestone. As aluminum solids and a significant amount of iron will be retained within the higher pH environment, in order to help sustain sufficient hydraulic conductivity and flow distribution, a flushing system will be incorporated into the underdrain consisting of two tiers of perforated pipes within the limestone.

The lower tier underdrain manifolds will be bedded on a 6-inch layer of AASHTO #57 aggregate placed on a geotextile pond liner. Upper tier piping is directly bedded within the layer of AASHTO #1 limestone.

This underdrain configuration will accomplish two objectives: first, enhanced flushing of accumulated metals by dividing the underdrains into several independent manifolds, each with a separate flush valve, and, second, flow control distribution throughout the treatment media by use of independently controlled outlet structures installed on each manifold. This design helps to ensure system efficacy and longevity.

Flush Pond

In order to maximize space utilization, a single flush pond will be installed for both Vertical Flow Ponds. During periodic flushing events, sludge accumulated within the limestone will be discharged to this component. Flushing events will be conducted on a

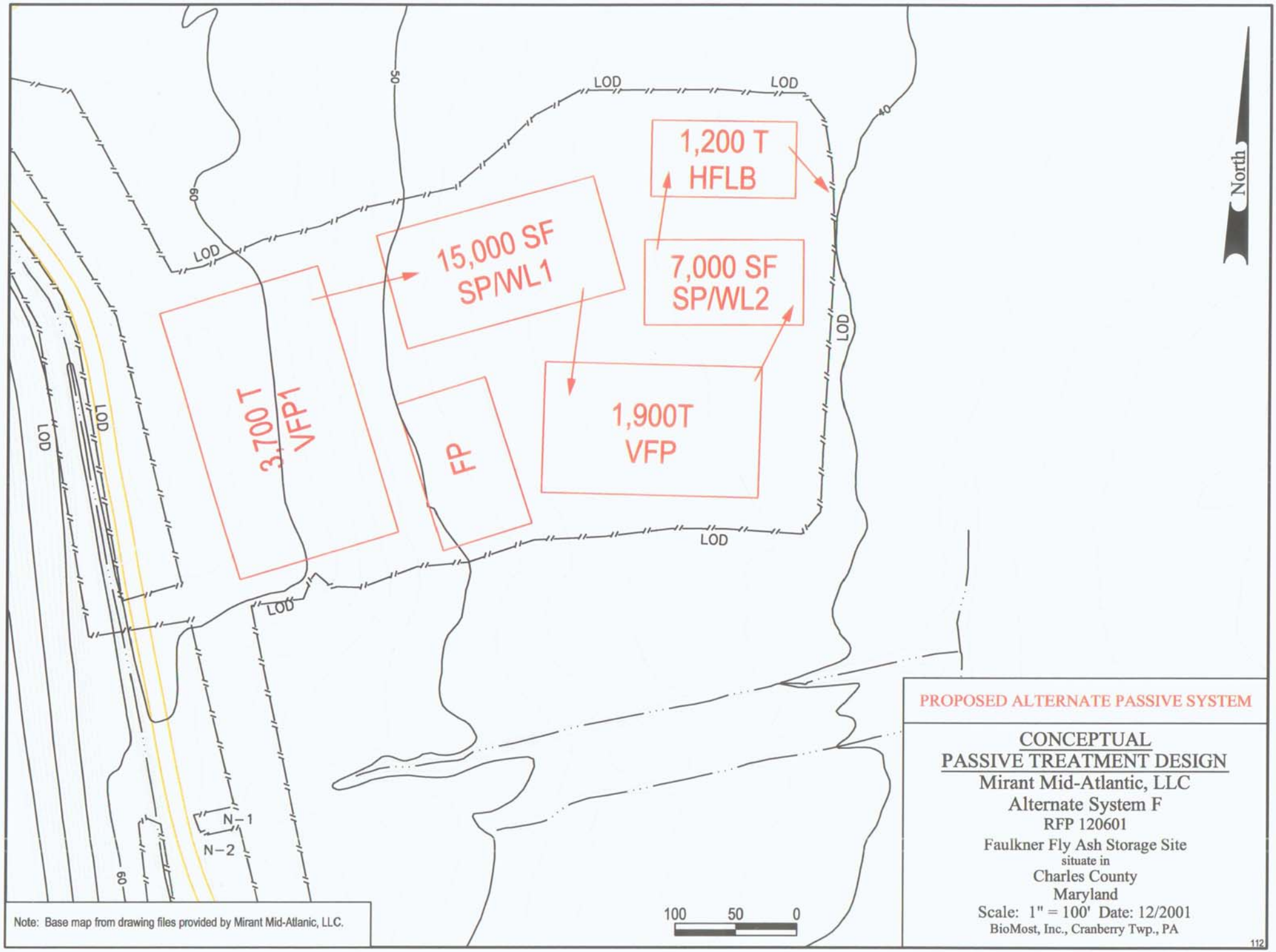
periodic basis determined by the pollutant loading.

Settling Pond/Aerobic Wetlands

These components are installed following Vertical Flow Ponds in order to allow the dissolved iron to oxidize and precipitate. The deeper water area (Settling Pond) will be followed by the shallower water area (Aerobic Wetland). The sizing criteria were based on the amount of metals that are expected to pass through the Vertical Flow Ponds. The passive treatment standard is 10-20 grams/square meter/day of iron removed. These wetlands are sized using the more conservative removal rate of 10 g/m^2/day. In addition, as iron concentrations are significantly decreased, removal rates also decrease; therefore, additional area has been included. The substrate will be 1 ½ feet in thickness and will consist of a 1-foot thick of on-site topsoil, or other suitable soil material, overlain by a 1:1 by volume mixture of spent mushroom compost and on-site topsoil. Sufficient freeboard is incorporated for accumulation of metal solids throughout the design life of the system.

Horizontal Flow Limestone Bed

Following the second and final wetland, this component is designed to receive the mostly treated discharge that will have very low iron (<3 mg/l) and aluminum (<1 mg/l) levels. The water passes through 90% calcium carbonate equivalent aggregate, adding alkalinity to the final effluent and decreasing significantly the dissolved manganese concentration. In addition, this component will act as a final polishing step prior to final discharge.



Note: Base map from drawing files provided by Mirant Mid-Atlantic, LLC.

PROPOSED ALTERNATE PASSIVE SYSTEM

CONCEPTUAL PASSIVE TREATMENT DESIGN

Mirant Mid-Atlantic, LLC
Alternate System F
RFP 120601
Faulkner Fly Ash Storage Site
situate in
Charles County
Maryland
Scale: 1" = 100' Date: 12/2001
BioMost, Inc., Cranberry Twp., PA

112