PRESENTATION OF SOLID PHASE BIOREMEDIATION DESIGN

for

TREATMENT OF CREOSOTE CONTAMINATED SOIL

Chicago & North Western Transportation Company
Southeast Minneapolis Yard

DAHL & ASSOCIATES, INC.
Environmental Consultants, Contractors & Engineers

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SAINT PAUL, MINNESOTA 55127

March 26, 1992

GENERAL OUTLINE

Presentation of Solid Phase Bioremediation Design
for
Treatment of Creosote Contaminated Soil
Chicago & North Western Southeast Minneapolis Yard

1. Summary of Site Assessment of Soil Contamination
    A. Phase I and Phase II Property Evaluation
    B. Biotreatability Investigation

2. Current and Future Site Use

3. Factors Taken into Consideration

4. Bioremediation Conceptual Design
    A. Engineering Design
    B. Equipment/Materials

5. Operation & Maintenance

6. QA/QC Plan

7. Safety Plan

8. Theoretical Project Timeline

9. Project Closure

SUMMARY OF PHASE I AND PHASE II PROPERTY EVALUATIONS

* Location Map - site located between 17th and 25th Avenues SE and 4th Street SE and Burlington Northern Property, known as C&NW Southeast Minneapolis Yards

* Former location of Republic Creosoting Company, in operation from 1903 through 1916 (now known as Reilly Tar & Chemical)

* Soil contamination identified as semi-volatile organic compounds, commonly referred to as polynuclear aromatic hydrocarbons (PAHs)

* Soil contamination identified at 3-6 feet below ground surface in area of former storage tanks and settling basins

* Total volume of contamination with overburden estimated to be approximately 1500 - 2000 cubic yards

SUMMARY OF BIOTREATABILITY INVESTIGATION

* Soil Sample Physical and Chemical Characterization
    - dark black color
    - typical creosote odor
    - 14% moisture
    - 86% total solids
        - 9% volatiles
        - 77% fixed solids
    - 33% fines soil fraction
    - 5682 ppm PAH concentration

* Biofeasibility screening with slurry reactor
    - final PAH concentration of 2052 ppm
    - 64 % overall reduction

* Open air pan reactor treatment
    - soil amended with 10% manure by dry weight of soil
    - pH, nutrient, and moisture levels controlled
    - aeration provided with tilling of soil
    - final PAH concentration after 120 days of 2170 ppm
    - 62 % total PAH reduction
    - at day 60, 50% PAH reduction
    - removal efficiencies of ring compounds comparison

* Closed vessel compost reactor treatment
    - soil amended with 10% wood chips by wet weight of soil
    - pH, nutrient, and moisture levels controlled
    - aeration provided by forced air
    - final PAH concentration after 120 days of 1773 ppm
    - 69% total PAH reduction
    - removal efficiencies of ring compounds comparison
    - at day 60, 39% PAH reduction

CURRENT AND FUTURE SITE USE

- University of Minnesota development

- new laboratory building
- Hazardous Waste Management Facility
- bus transitway
- parking lots

CONSIDERATIONS

* total treatment time required
* moisture addition and monitoring
* aeration addition and monitoring
* pH addition and monitoring
* nutrient addition and monitoring
* precipitation control
* excess moisture control
* odor control
* dust control
* temperature control
* space utilization
* current and future site use
* visual profile/public accessibility
* available "active" biodegradation months
* extension of "active" biodegradation months
* "hot spots" potential
* future remediated soil use

BIOREMEDIATION CONCEPTUAL DESIGN

Combined Prepared Bed Land Treatment/Compost Treatment

Summary: 68'wide x 188'long x 4'deep treatment bed with air supplied by application of a vacuum for the lower treatment zone, tractor tilling of soil of upper treatment zone, all enclosed within a building. Control of pH, moisture and nutrients levels. Two soil applications of 1800 cubic yards each.

General Design Assumptions:

1. Impacted soil preparation
   - screened for rubble, pulverized to a consistent size

2. Impacted soil amendment
   - addition of wood chips
     to provide bulk for aeration purposes
     maximum 10% by dry weight of soil (wood chip density of 35#/cubic foot)
   - addition of manure
     to provide bulk for aeration purposes and nutrients for microbial growth
     maximum 3.5% by dry weight of soil (manure density of 12#/cubic foot)

3. Total soil volume
   - excavation of 2000 cubic yards
   - density of 100#/cubic foot
   - fluff factor of 7%
   - total volume of 3600 cubic yards soil to be treated

4. Two soil applications
   - 1800 cubic yards each
   - first application removed after remediated, second application then applied
   - second application stockpiled and covered until applied
   - stockpile dimensions 60'wide x 10'high x 160'long
   - second application amended with wood chips/ manure for remediation while stockpiled

5. Treatment area
    - maximum treatment depth of 4 feet
    - 1:2 slopes
    - area required for one application
        base 60'wide x 180'long
        surface 68'wide x 188'long
    - totally enclosed within a pole barn building
        no center poles
        12 foot high side clearance
        roof vents, soffit vents
        80'wide x 200'long
    - location

6. Treatment area construction and components
    - excavation of bed to 5 feet below ground surface
    - bed surface rolled and packed
    - bottom of bed 1% slope
    - 1 foot ballast of 1/4" rounded pearock
    - forced aeration system on bottom of ballast
        - series of 2-inch, slotted PVC air extraction pipes with 10 foot long screened section on 10 foot centers on bottom
        - inlet manifolds, moisture traps, orifice assembly, rotron blowers located on ground surface at side of treatment bed
        - vented through roof
    - geotextile fabric covering ballast for protection of piping and prevention of fines washing into ballast

7. Machinery
    - tractor
      chisel plow - 12-14 inch plow depth
      harrow rack - smooth
      spray tank for nutrient and moisture addition

OPERATION AND MAINTENANCE

1. Surface treatment area divided into subcells
    - 34'wide x 50'long per subcell
    - 8 subcells
    - tillage zone
    - compost zone

2. Indicator parameters done at site
    - pH
    - nutrients levels
      nitrate as N
      Phosphate as P
      ammonia as N
    - % moisture content
    - soil temperature
    - air temperature
    - odor description
    - color description

3. Laboratory analysis
    - PAH analysis of soil samples
    - PAH analysis of air emissions

4. PAH analysis of soil samples
    - 2 composite samples per subcell per PAH soil sampling event
        - 4 random samples into one tillage zone sample
        - 4 random samples into one compost zone
        - total of 16 PAH analysis per sampling event
    - sample schedule will be dependent upon month soil applied, weather during each season, and progress of degradation
    - no soil sampling for PAH during winter months
    - sample schedule
        - week 0
        - week 6
        - 16 weeks (just prior to winter season)
        - 4-6 weeks into spring season
        - 10-12 weeks
        - 16-18 weeks (if necessary)

5. Air emissions monitoring
    - collection of air exhaust samples from each side for PAH analysis
    - sample schedule
        - week 1
        - week 2
        - monthly thereafter
    - air emissions control will be addressed if necessary

6. Maintenance of treatment zone
    - Tilling and indicator parameters schedule
        - once per week for week 0-6
        - biweekly from week 6 to winter season
        - monthly during winter season if possible
        - once per week during spring and summer seasons

7. pH control
        - addition of lime as necessary
        - maintain pH at approximately 7.0

8. Moisture control
        - maintain between 60-70% field capacity
        - field capacity to be measured when soil amended

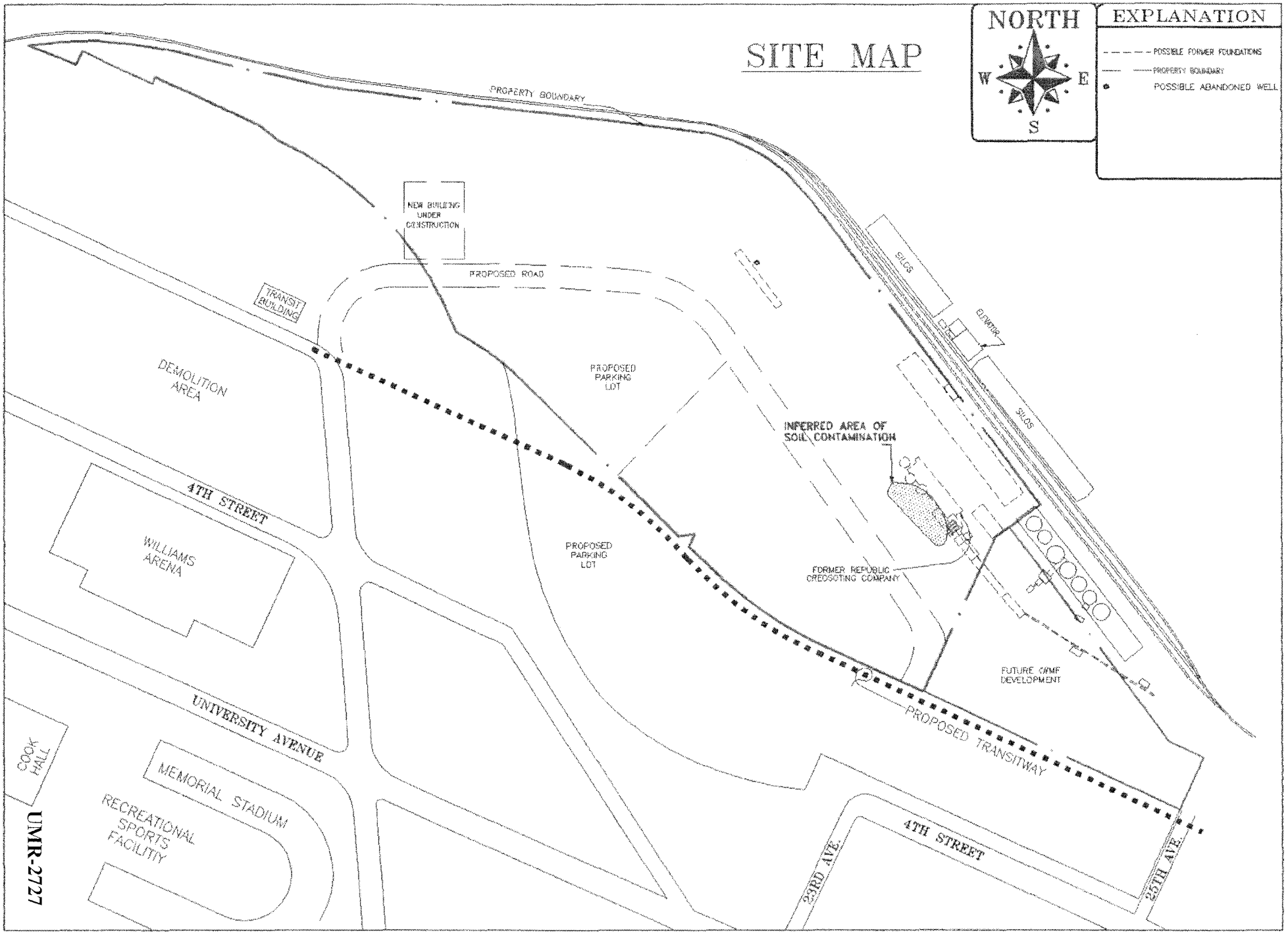
9. Nutrient additions
        - ammonium nitrate for nitrogen
        - trisodium phosphate for phosphate
        - target C:N:P 50:2:1
        - nutrients will be applied in small doses

BENEFITS OF PROPOSED TREATMENT SYSTEM

- treatment area completely covered by building
  - better odor control
  - better dust control
  - better temperature control (extension of active degradation months)
  - no visual profile
  - no need for precipitation control
  - easy access to soil, rectify hot spots
  - no public access/low profile
- air emissions control
- two sources of air supplied - tilling and forced
- moisture addition control
- pH adjustment control
- nutrient addition control

QUALITY CONTROL/QUALITY ASSURANCE

- treatment bed subcells staked
- same environmental technicians
- subcell composite buckets assigned
- detailed field data sheets
- work station located inside building
- samples mapped at each sampling event
- duplicate samples to be scheduled
- detailed plan to follow


SITE MAP
NORTH
W
E
S
EXPLANATION
POSSIBLE FORMER FOUNDATIONS
PROPERTY BOUNDARY
POSSIBLE ABANDONED WELL
PROPERTY BOUNDARY
NEW BUILDING UNDER CONSTRUCTION
PROPOSED ROAD
TRANSIT BUILDING
DEMOLITION AREA
PROPOSED PARKING LOT
SILOS
ELEVATOR
SILOS
INFERRED AREA OF SOIL CONTAMINATION
4TH STREET
WILLIAMS ARENA
PROPOSED PARKING LOT
FORMER REPUBLIC CREOSOTING COMPANY
FUTURE OMF DEVELOPMENT
UNIVERSITY AVENUE
PROPOSED TRANSITWAY
COOK HALL
MEMORIAL STADIUM
RECREATIONAL SPORTS FACILITY
23RD AVE.
4TH STREET
25TH AVE.
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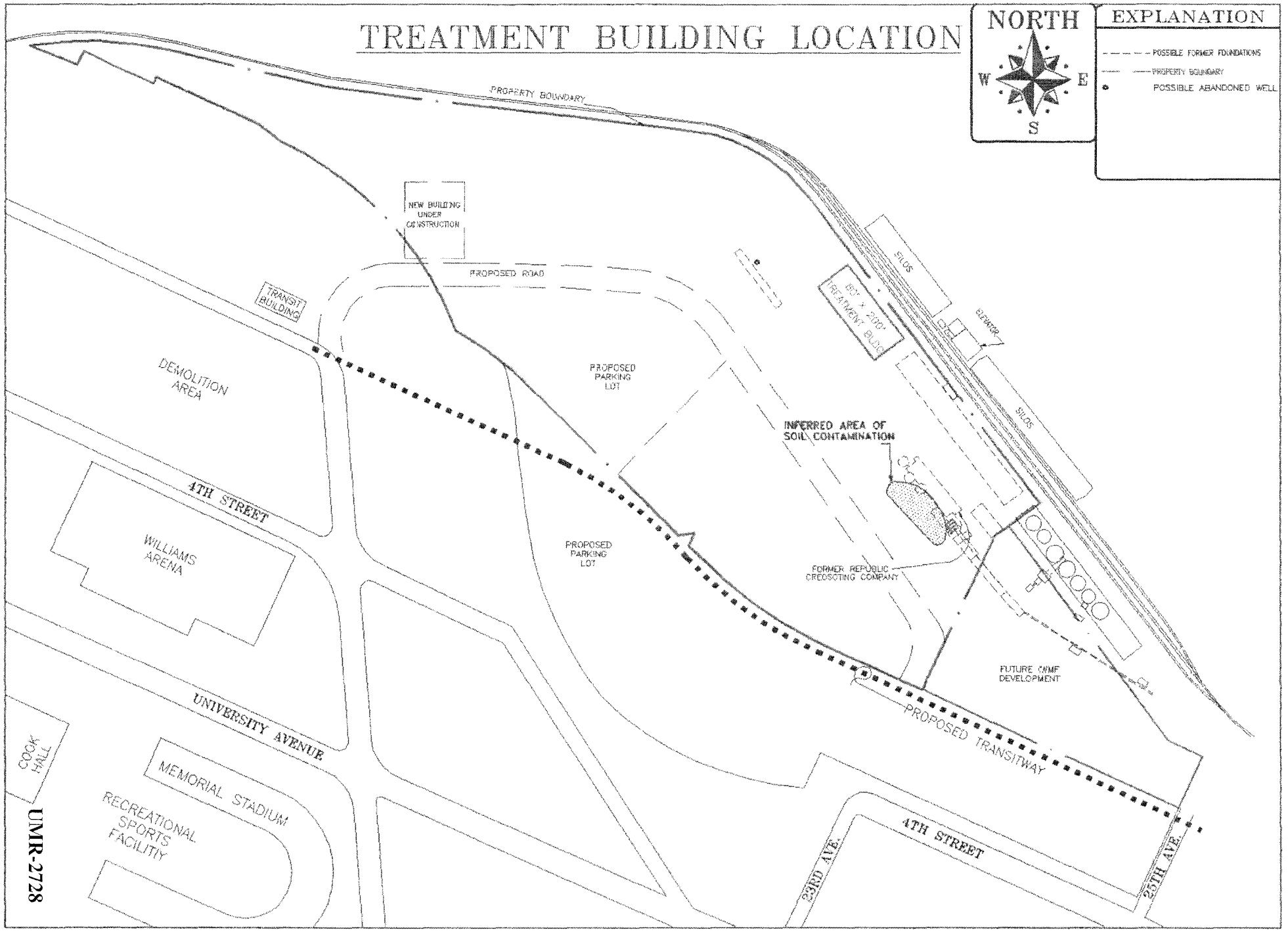
TREATMENT BUILDING LOCATION



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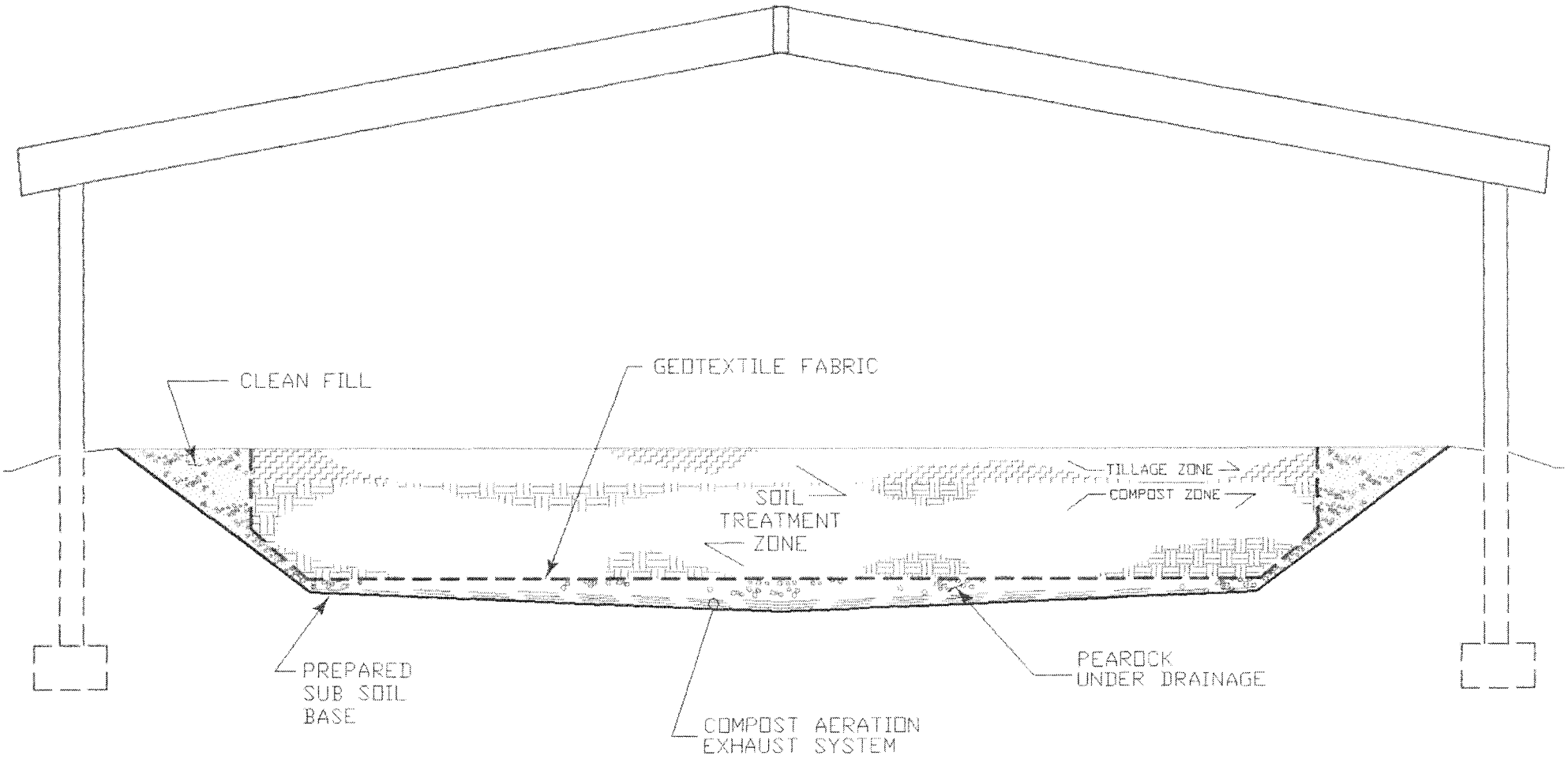
COMBINED PREPARED BED LAND / COMPOST TREATMENT



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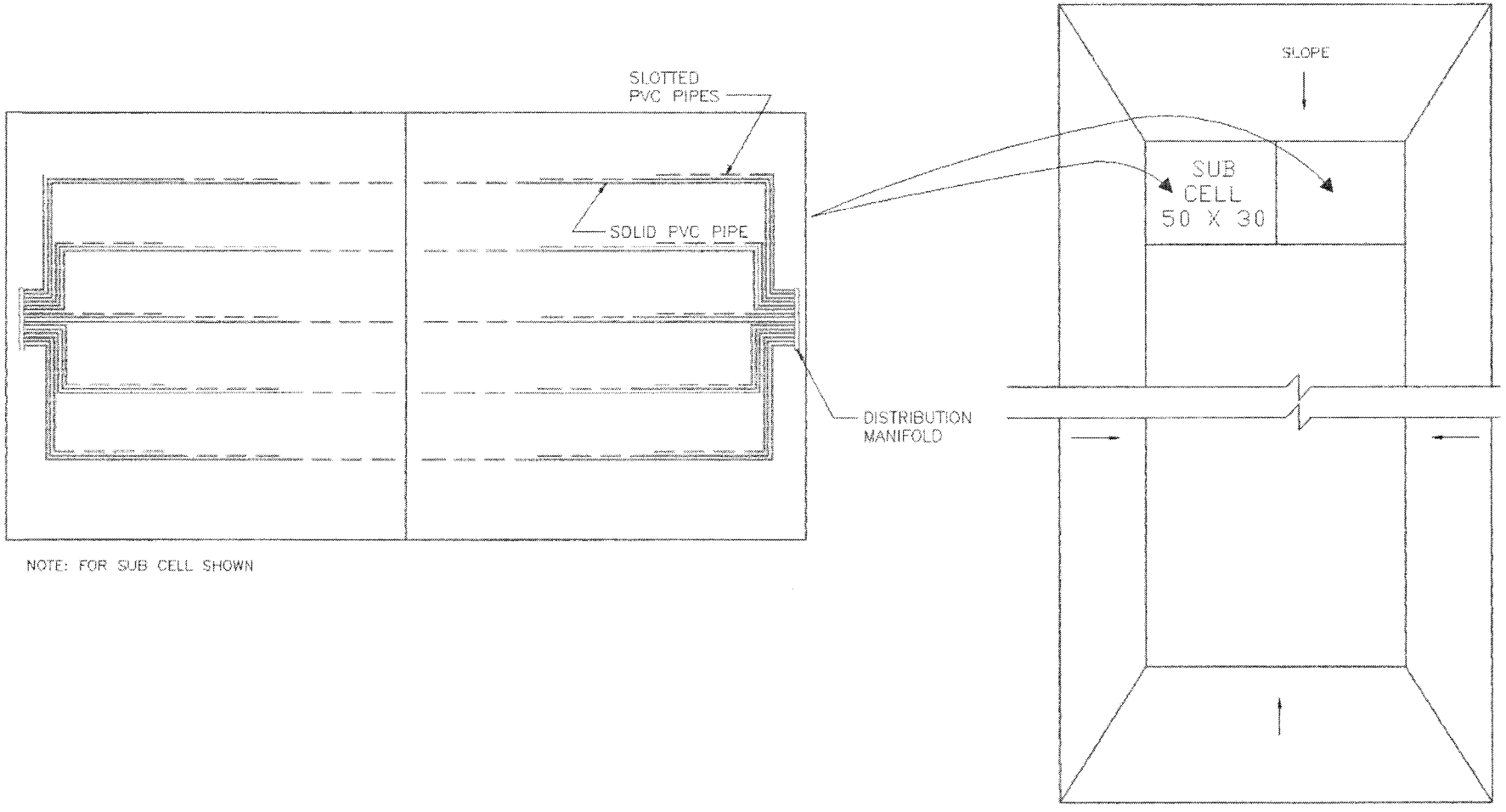
COMPOST TREATMENT

TYPICAL COMPOST AERATION EXHAUST SYSTEM



NOTE: FOR SUB CELL SHOWN

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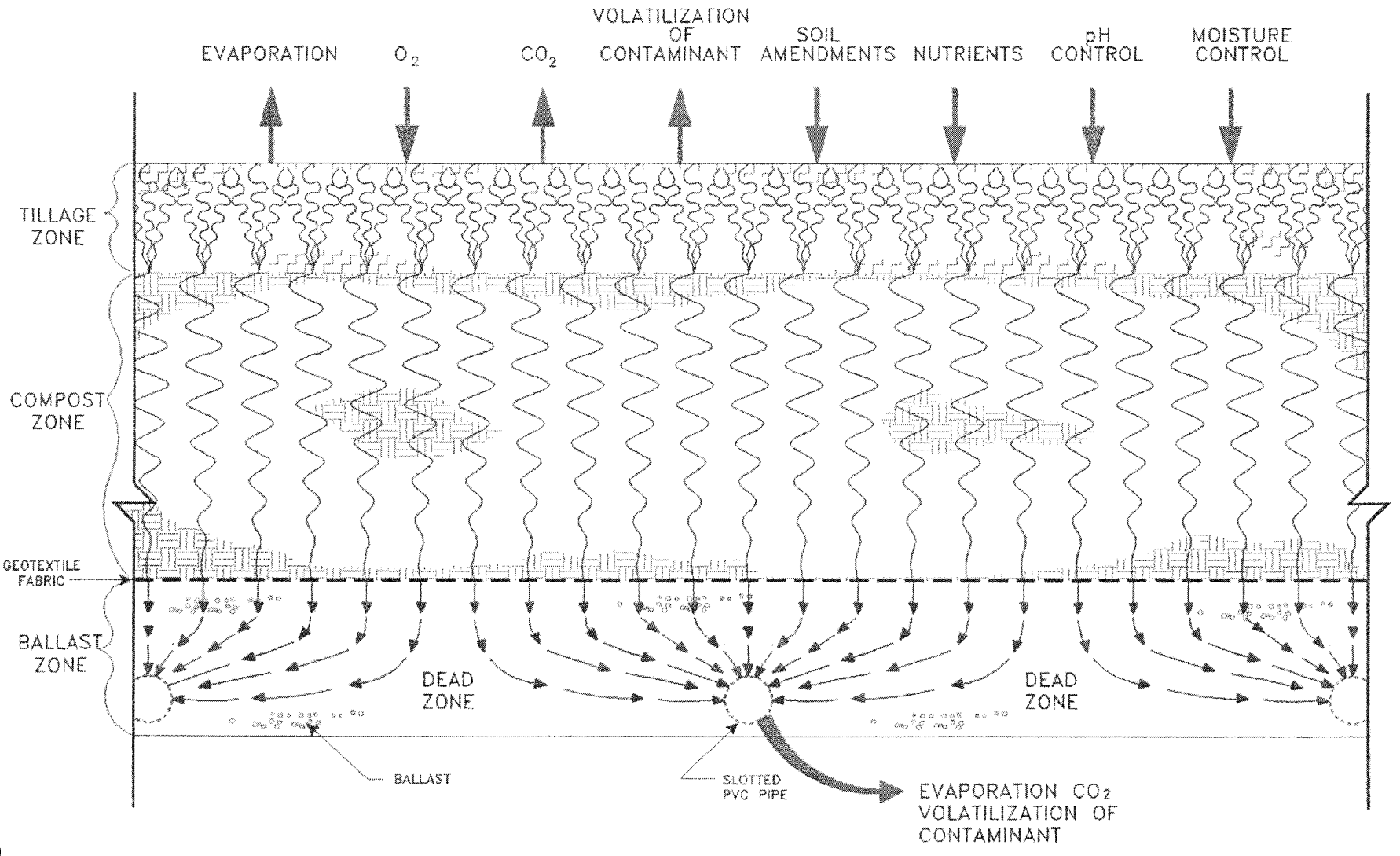
CONCEPTUAL AIR FLOW



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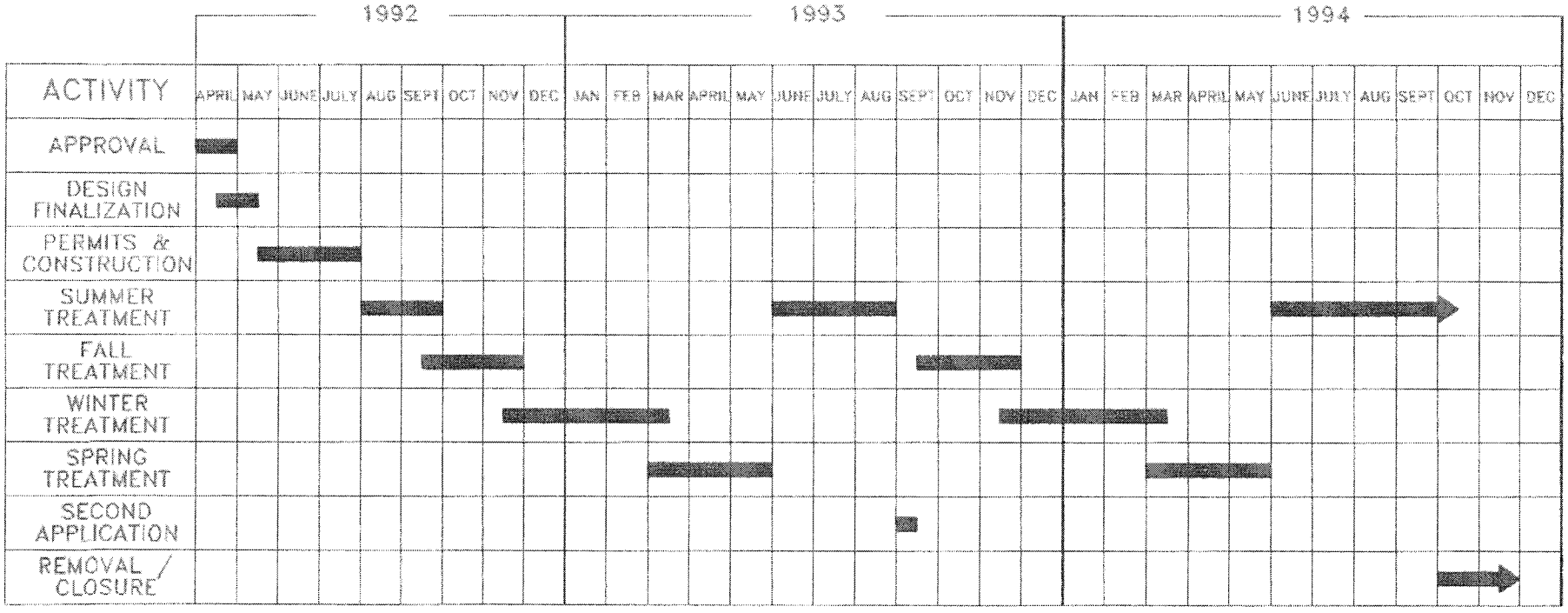
TWO APPLICATIONS
THEORETICAL PROJECT TIMELINE



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