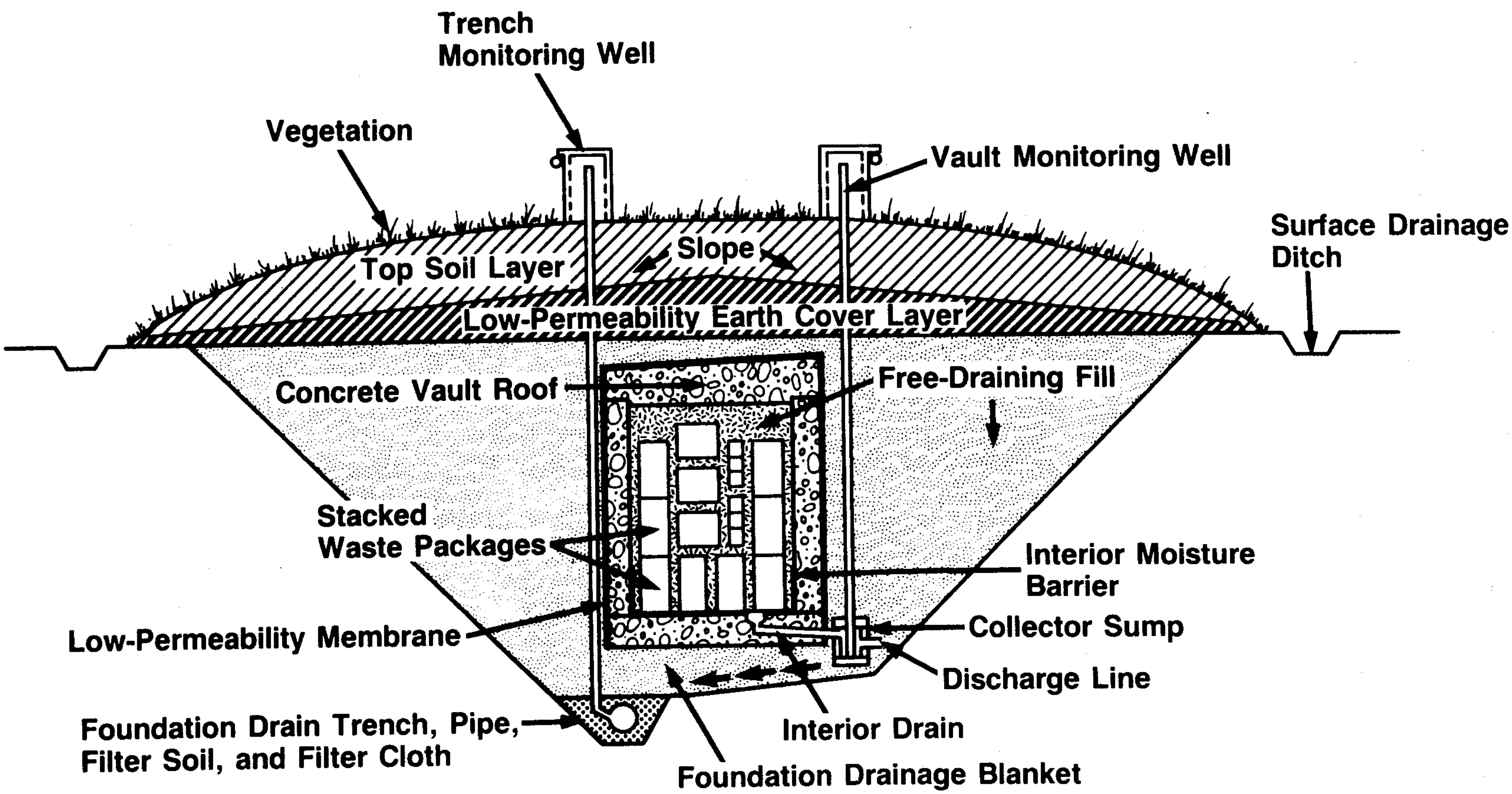

Trench
Monitoring Well
Vegetation
Vault Monitoring Well
Surface Drainage
Ditch
Top Soil Layer
Slope
Low-Permeability Earth Cover Layer
Concrete Vault Roof
Free-Draining Fill
Stacked
Waste Packages
Interior Moisture
Barrier
Collector Sump
Low-Permeability Membrane
Discharge Line
Foundation Drain Trench, Pipe,
Filter Soil, and Filter Cloth
Interior Drain
Foundation Drainage Blanket

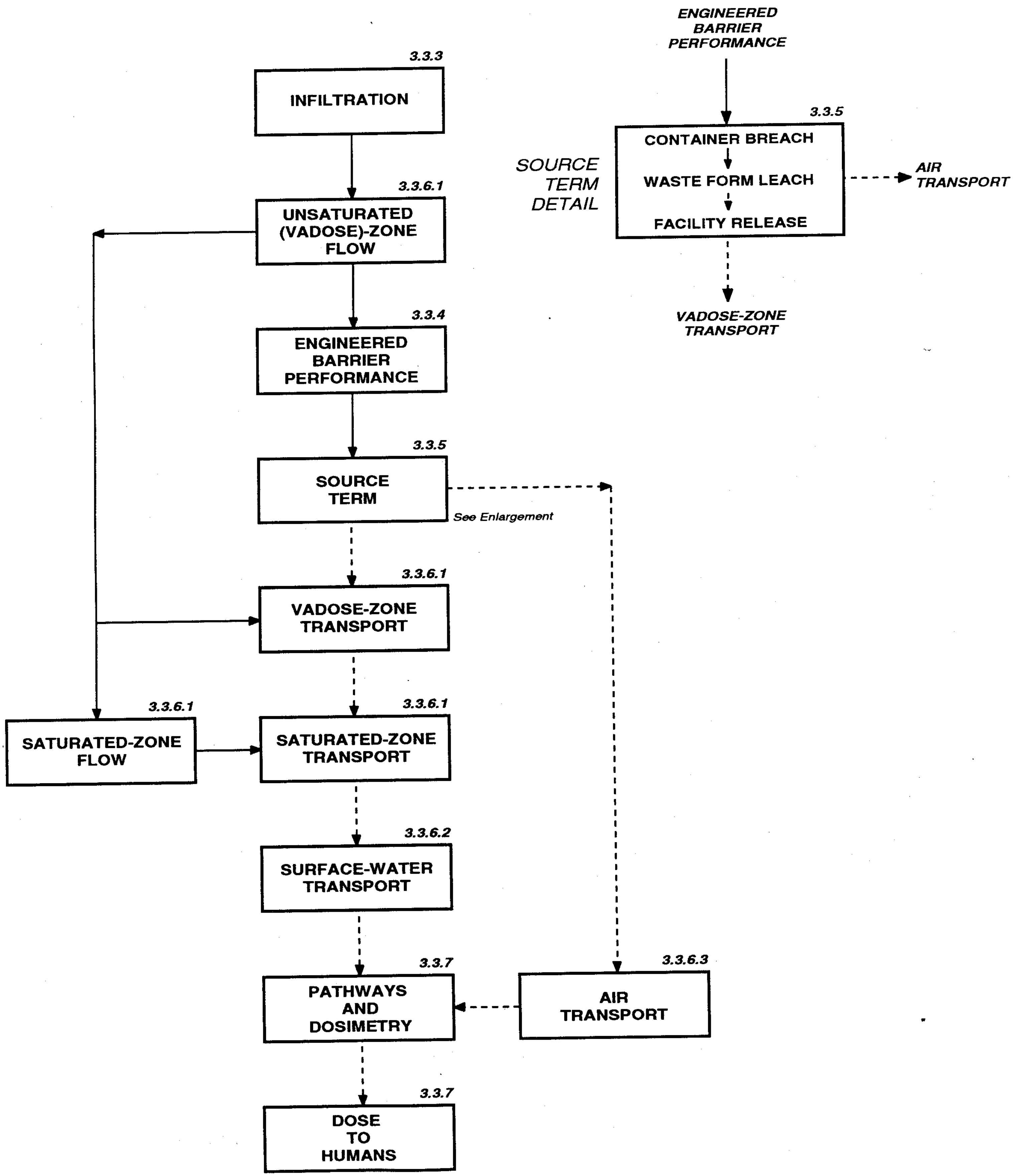

ENGINEERED BARRIER PERFORMANCE
3.3.5
CONTAINER BREACH
WASTE FORM LEACH
FACILITY RELEASE
SOURCE TERM DETAIL
AIR TRANSPORT
VADOSE-ZONE TRANSPORT
3.3.3
INFILTRATION
3.3.6.1
UNSATURATED (VADOSE)-ZONE FLOW
3.3.4
ENGINEERED BARRIER PERFORMANCE
3.3.5
SOURCE TERM
See Enlargement
3.3.6.1
VADOSE-ZONE TRANSPORT
3.3.6.1
SATURATED-ZONE FLOW
3.3.6.1
SATURATED-ZONE TRANSPORT
3.3.6.2
SURFACE-WATER TRANSPORT
3.3.7
PATHWAYS AND DOSIMETRY
3.3.6.3
AIR TRANSPORT
3.3.7
DOSE TO HUMANS

FIG 2

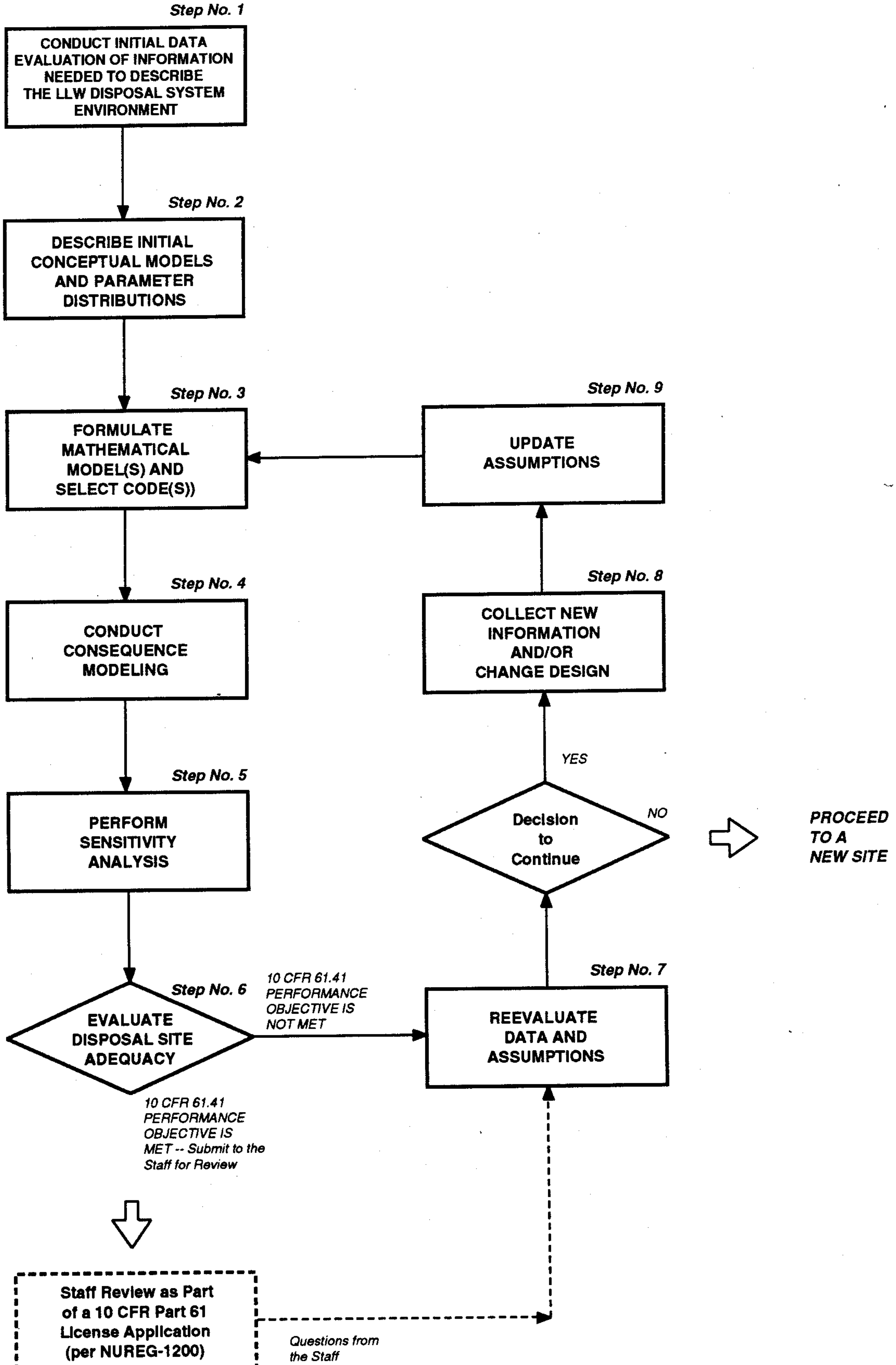

Step No. 1
CONDUCT INITIAL DATA EVALUATION OF INFORMATION NEEDED TO DESCRIBE THE LLW DISPOSAL SYSTEM ENVIRONMENT
Step No. 2
DESCRIBE INITIAL CONCEPTUAL MODELS AND PARAMETER DISTRIBUTIONS
Step No. 3
FORMULATE MATHEMATICAL MODEL(S) AND SELECT CODE(S))
Step No. 4
CONDUCT CONSEQUENCE MODELING
Step No. 5
PERFORM SENSITIVITY ANALYSIS
Step No. 6
EVALUATE DISPOSAL SITE ADEQUACY
10 CFR 61.41 PERFORMANCE OBJECTIVE IS NOT MET
10 CFR 61.41 PERFORMANCE OBJECTIVE IS MET -- Submit to the Staff for Review
Staff Review as Part of a 10 CFR Part 61 License Application (per NUREG-1200)
Questions from the Staff
Step No. 7
REEVALUATE DATA AND ASSUMPTIONS
Decision to Continue
YES
NO
PROCEED TO A NEW SITE
Step No. 8
COLLECT NEW INFORMATION AND/OR CHANGE DESIGN
Step No. 9
UPDATE ASSUMPTIONS

FIG 3

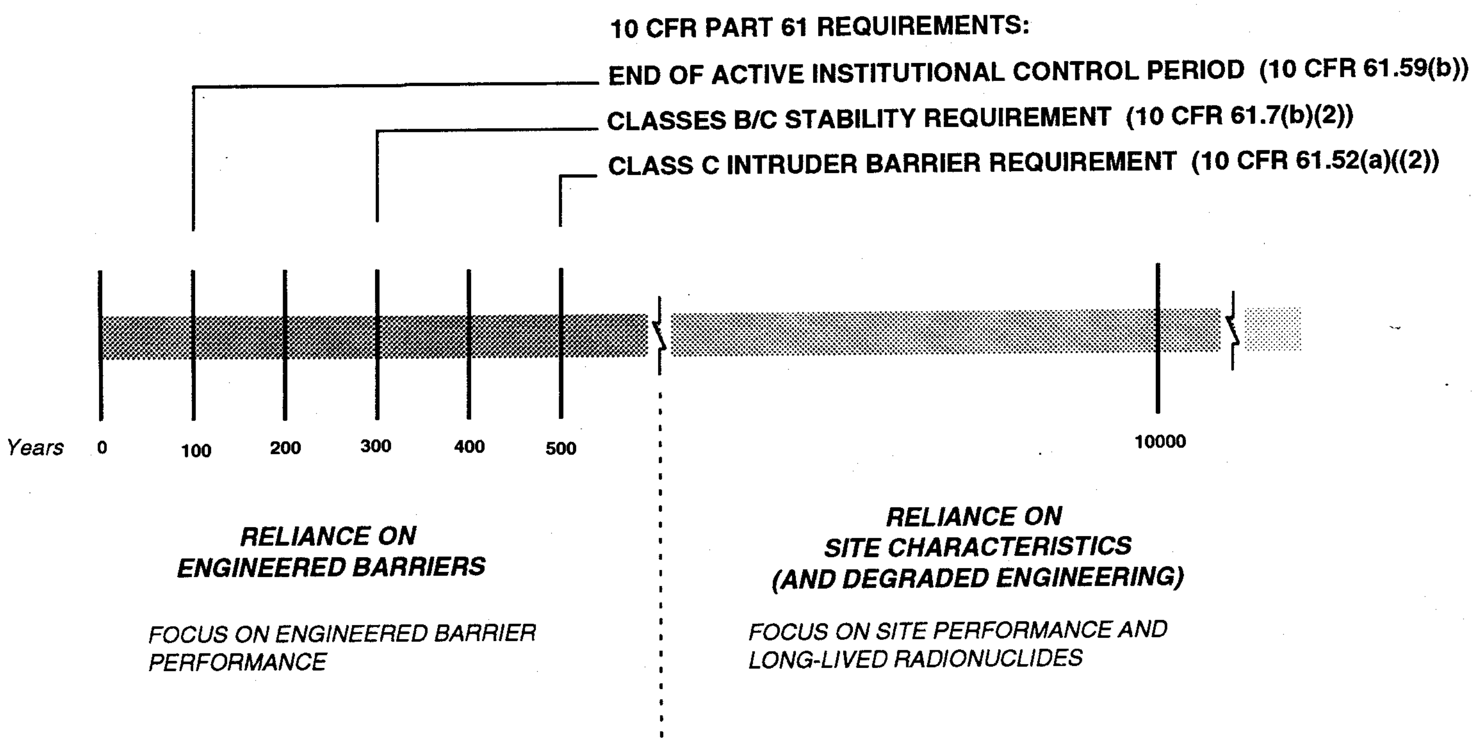
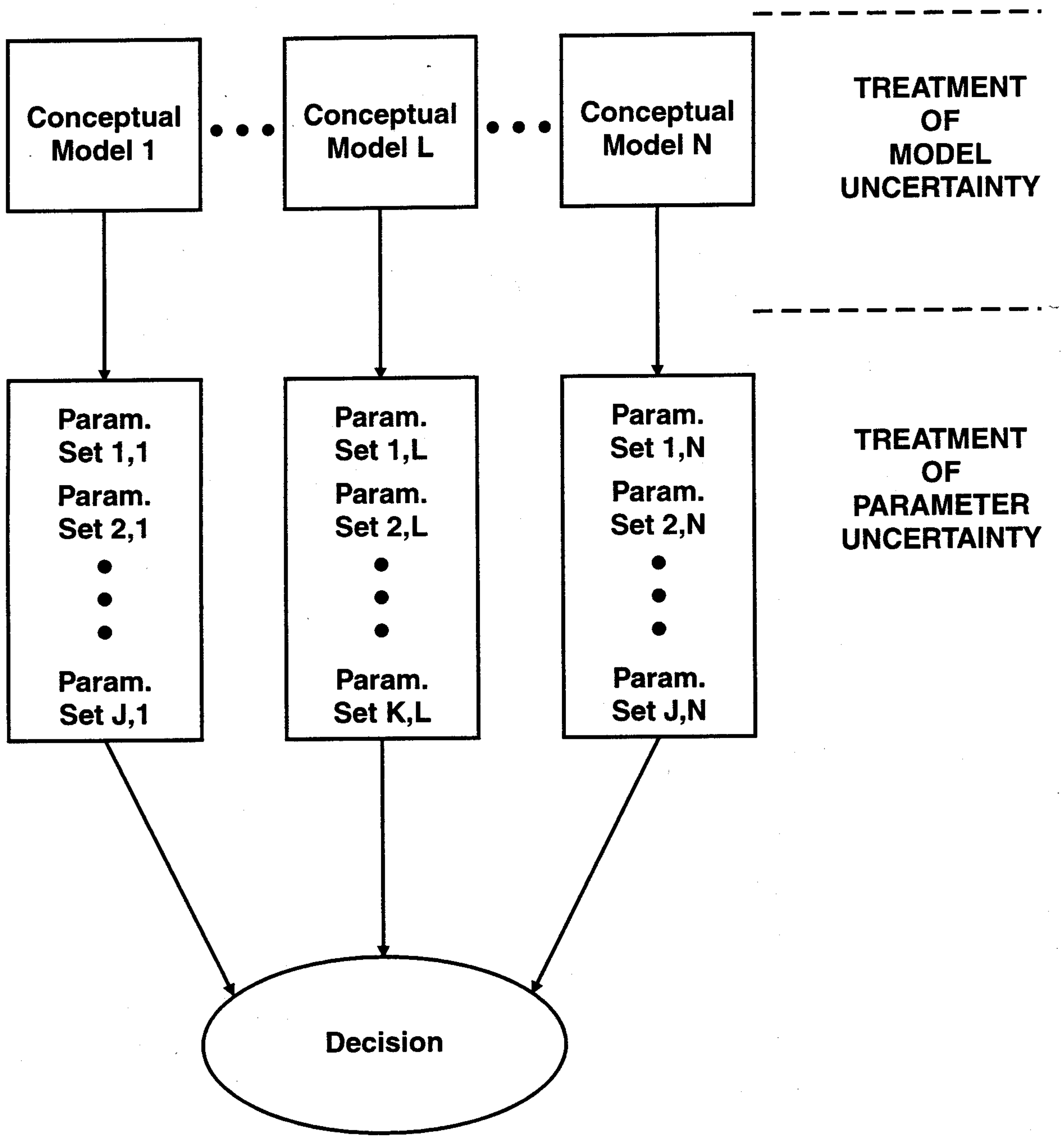

10 CFR PART 61 REQUIREMENTS:
END OF ACTIVE INSTITUTIONAL CONTROL PERIOD (10 CFR 61.59(b))
CLASSES B/C STABILITY REQUIREMENT (10 CFR 61.7(b)(2))
CLASS C INTRUDER BARRIER REQUIREMENT (10 CFR 61.52(a)((2))
Years
0
100
200
300
400
500
10000
RELIANCE ON
ENGINEERED BARRIERS
FOCUS ON ENGINEERED BARRIER PERFORMANCE
RELIANCE ON
SITE CHARACTERISTICS
(AND DEGRADED ENGINEERING)
FOCUS ON SITE PERFORMANCE AND LONG-LIVED RADIONUCLIDES

FIG 4



Conceptual Model 1
Conceptual Model L
Conceptual Model N
TREATMENT OF MODEL UNCERTAINTY
Param. Set 1,1
Param. Set 2,1
Param. Set J,1
Param. Set 1,L
Param. Set 2,L
Param. Set K,L
Param. Set 1,N
Param. Set 2,N
Param. Set J,N
TREATMENT OF PARAMETER UNCERTAINTY
Decision

FIG 5

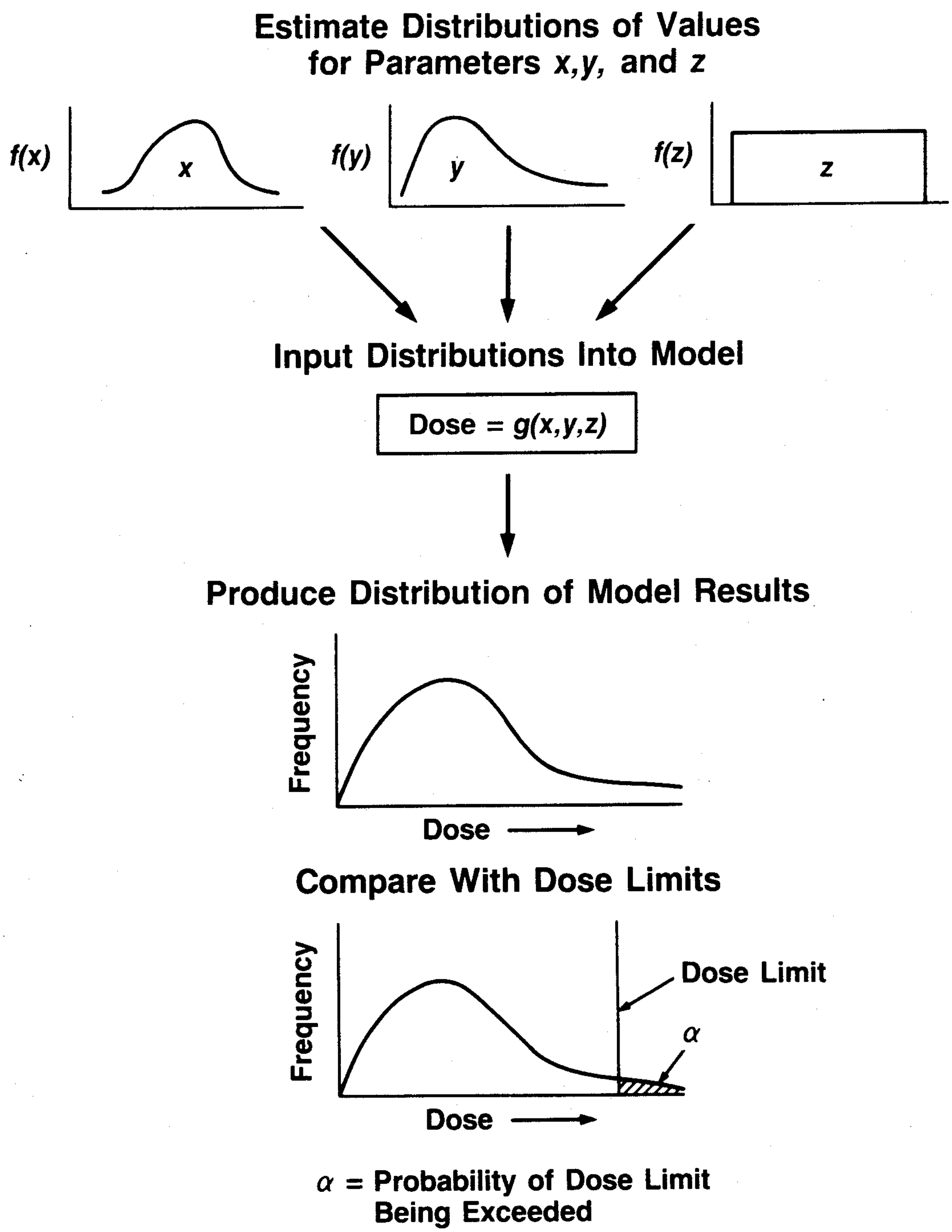

Estimate Distributions of Values
for Parameters x,y, and z
f(x)
x
f(y)
y
f(z)
z
Input Distributions Into Model
Dose = g(x,y,z)
Produce Distribution of Model Results
Frequency
Dose
Compare With Dose Limits
Frequency
Dose Limit
α
Dose
α = Probability of Dose Limit
Being Exceeded

FIG 6

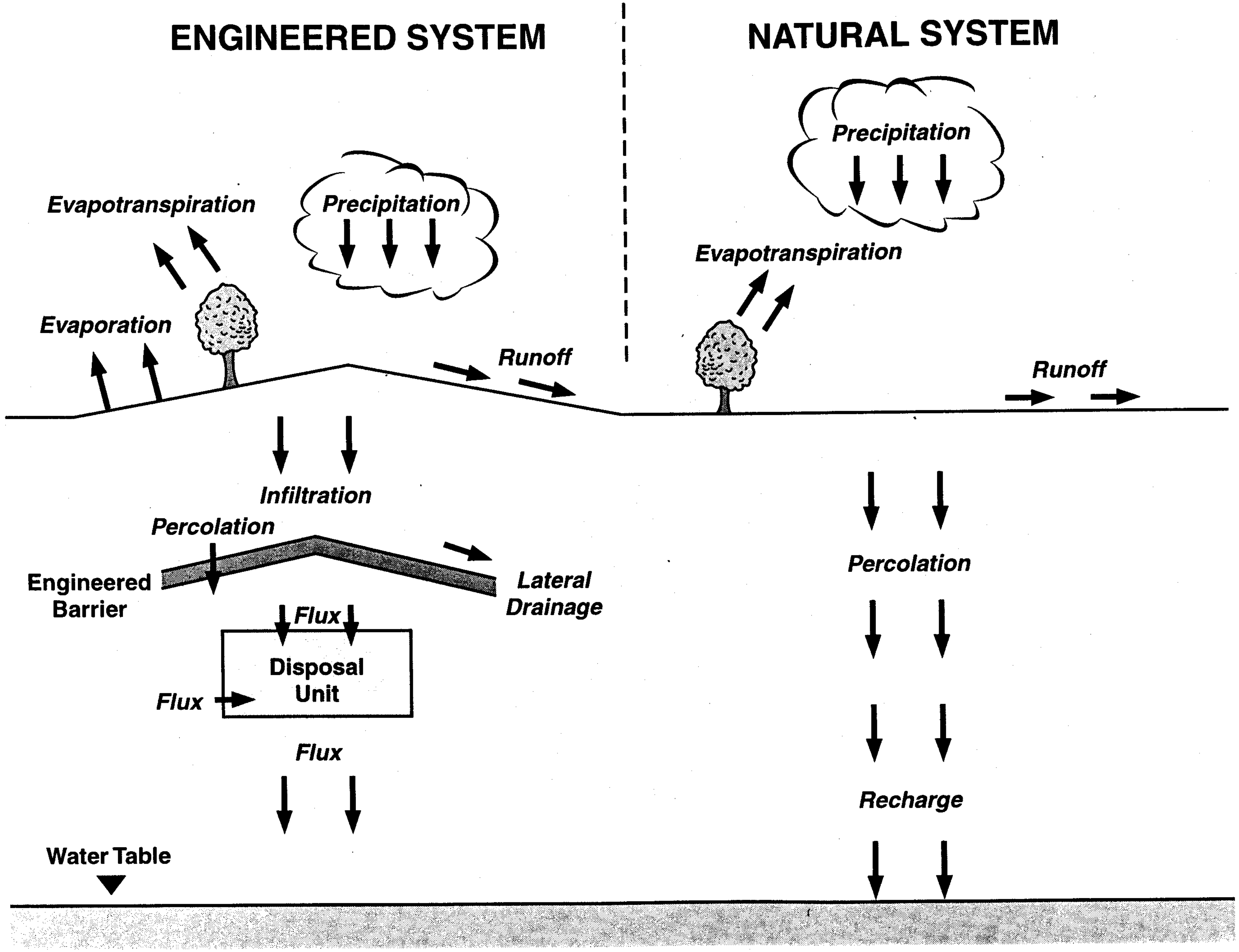

ENGINEERED SYSTEM
NATURAL SYSTEM
Evapotranspiration
Precipitation
Evaporation
Runoff
Infiltration
Percolation
Engineered Barrier
Lateral Drainage
Flux
Disposal Unit
Flux
Flux
Water Table
Precipitation
Evapotranspiration
Runoff
Percolation
Recharge

Fig 7

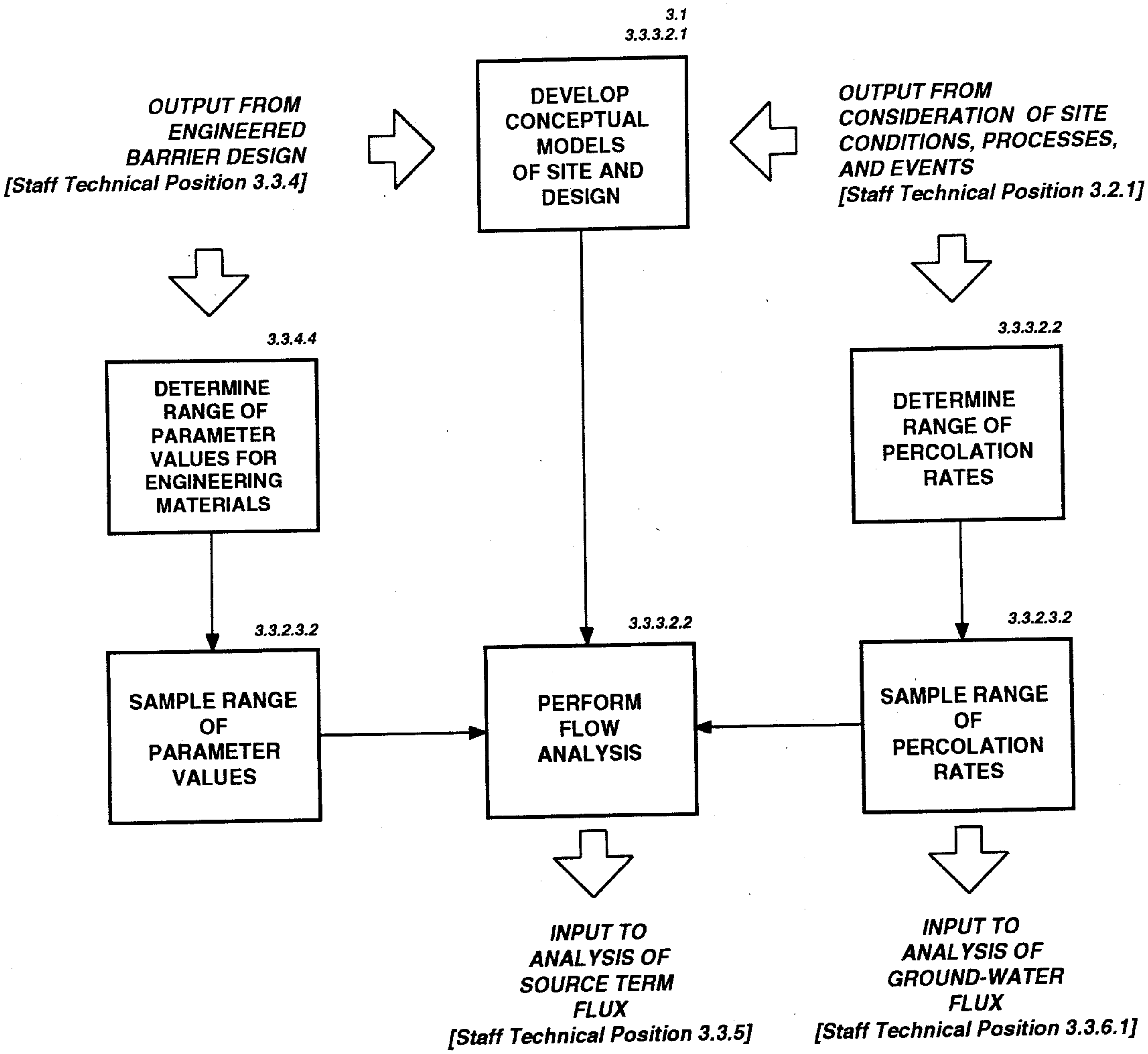

3.1
3.3.3.2.1
DEVELOP CONCEPTUAL MODELS OF SITE AND DESIGN
OUTPUT FROM ENGINEERED BARRIER DESIGN [Staff Technical Position 3.3.4]
OUTPUT FROM CONSIDERATION OF SITE CONDITIONS, PROCESSES, AND EVENTS [Staff Technical Position 3.2.1]
3.3.4.4
DETERMINE RANGE OF PARAMETER VALUES FOR ENGINEERING MATERIALS
3.3.3.2.2
DETERMINE RANGE OF PERCOLATION RATES
3.3.2.3.2
SAMPLE RANGE OF PARAMETER VALUES
3.3.3.2.2
PERFORM FLOW ANALYSIS
3.3.2.3.2
SAMPLE RANGE OF PERCOLATION RATES
INPUT TO ANALYSIS OF SOURCE TERM FLUX [Staff Technical Position 3.3.5]
INPUT TO ANALYSIS OF GROUND-WATER FLUX [Staff Technical Position 3.3.6.1]

FIG 8

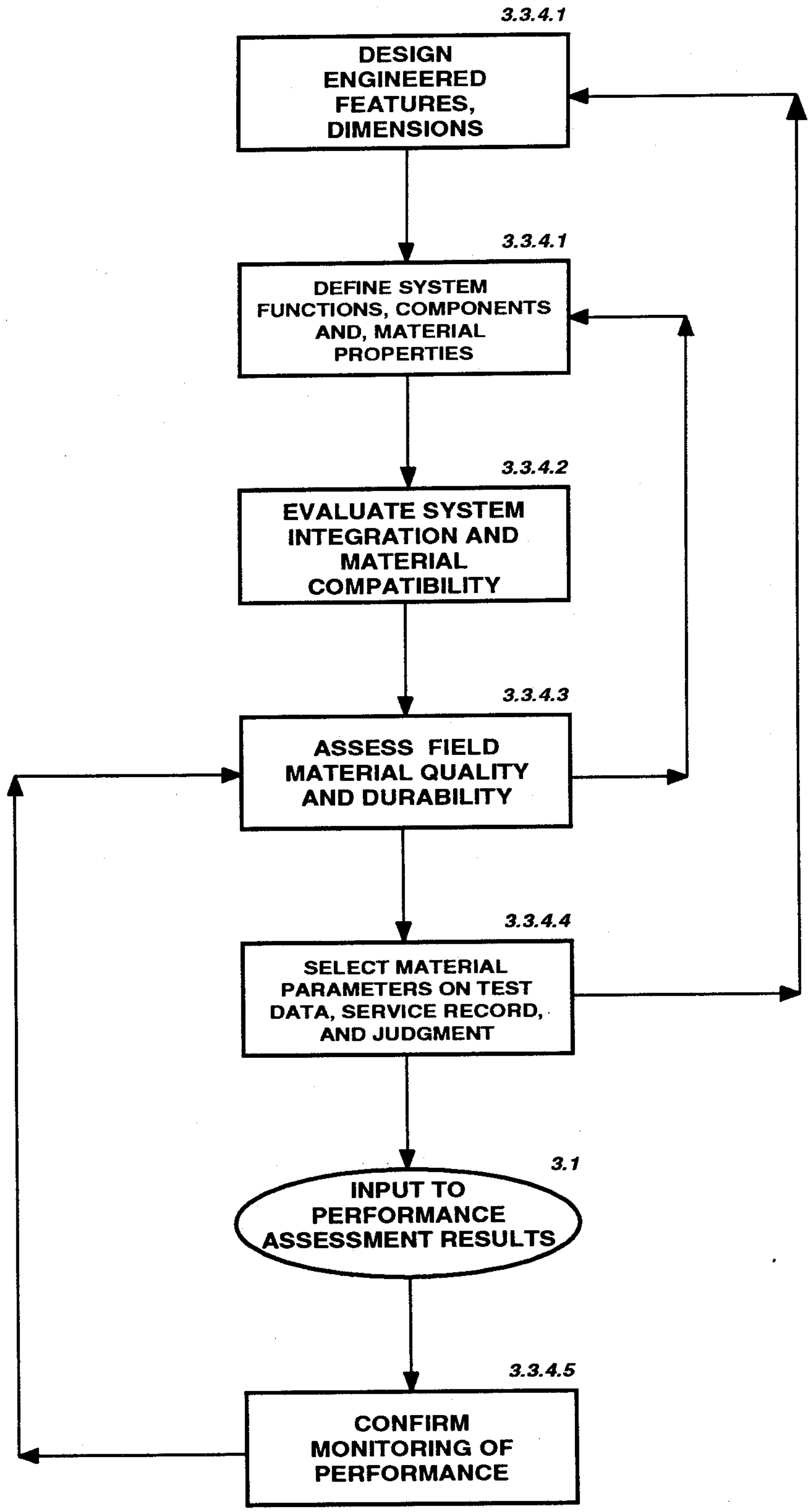

3.3.4.1
DESIGN ENGINEERED FEATURES, DIMENSIONS
3.3.4.1
DEFINE SYSTEM FUNCTIONS, COMPONENTS AND, MATERIAL PROPERTIES
3.3.4.2
EVALUATE SYSTEM INTEGRATION AND MATERIAL COMPATIBILITY
3.3.4.3
ASSESS FIELD MATERIAL QUALITY AND DURABILITY
3.3.4.4
SELECT MATERIAL PARAMETERS ON TEST DATA, SERVICE RECORD, AND JUDGMENT
3.1
INPUT TO PERFORMANCE ASSESSMENT RESULTS
3.3.4.5
CONFIRM MONITORING OF PERFORMANCE

FIG 9

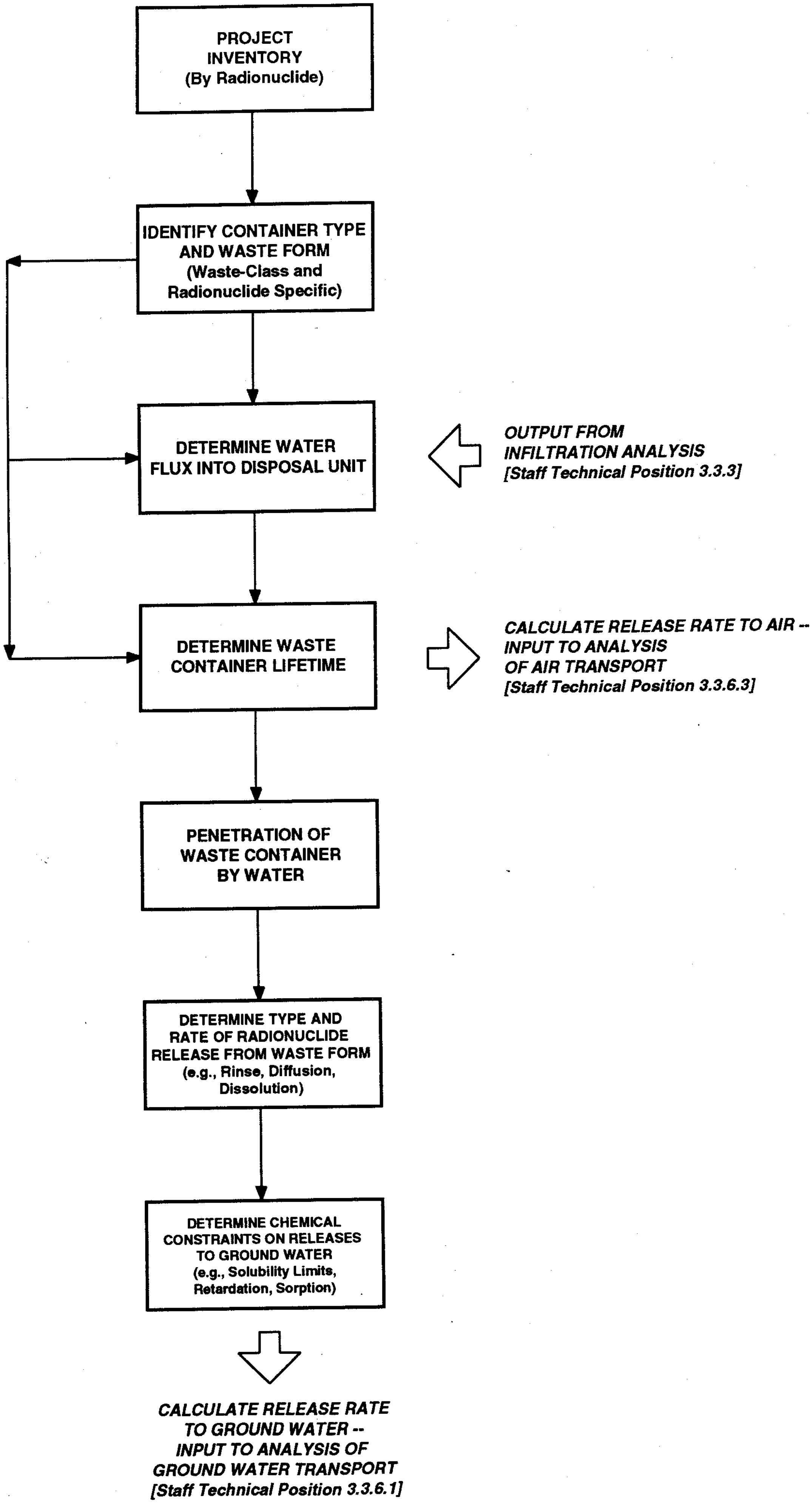

PROJECT INVENTORY (By Radionuclide)
IDENTIFY CONTAINER TYPE AND WASTE FORM (Waste-Class and Radionuclide Specific)
DETERMINE WATER FLUX INTO DISPOSAL UNIT
OUTPUT FROM INFILTRATION ANALYSIS [Staff Technical Position 3.3.3]
DETERMINE WASTE CONTAINER LIFETIME
CALCULATE RELEASE RATE TO AIR -- INPUT TO ANALYSIS OF AIR TRANSPORT [Staff Technical Position 3.3.6.3]
PENETRATION OF WASTE CONTAINER BY WATER
DETERMINE TYPE AND RATE OF RADIONUCLIDE RELEASE FROM WASTE FORM (e.g., Rinse, Diffusion, Dissolution)
DETERMINE CHEMICAL CONSTRAINTS ON RELEASES TO GROUND WATER (e.g., Solubility Limits, Retardation, Sorption)
CALCULATE RELEASE RATE TO GROUND WATER -- INPUT TO ANALYSIS OF GROUND WATER TRANSPORT [Staff Technical Position 3.3.6.1]

FIG 10

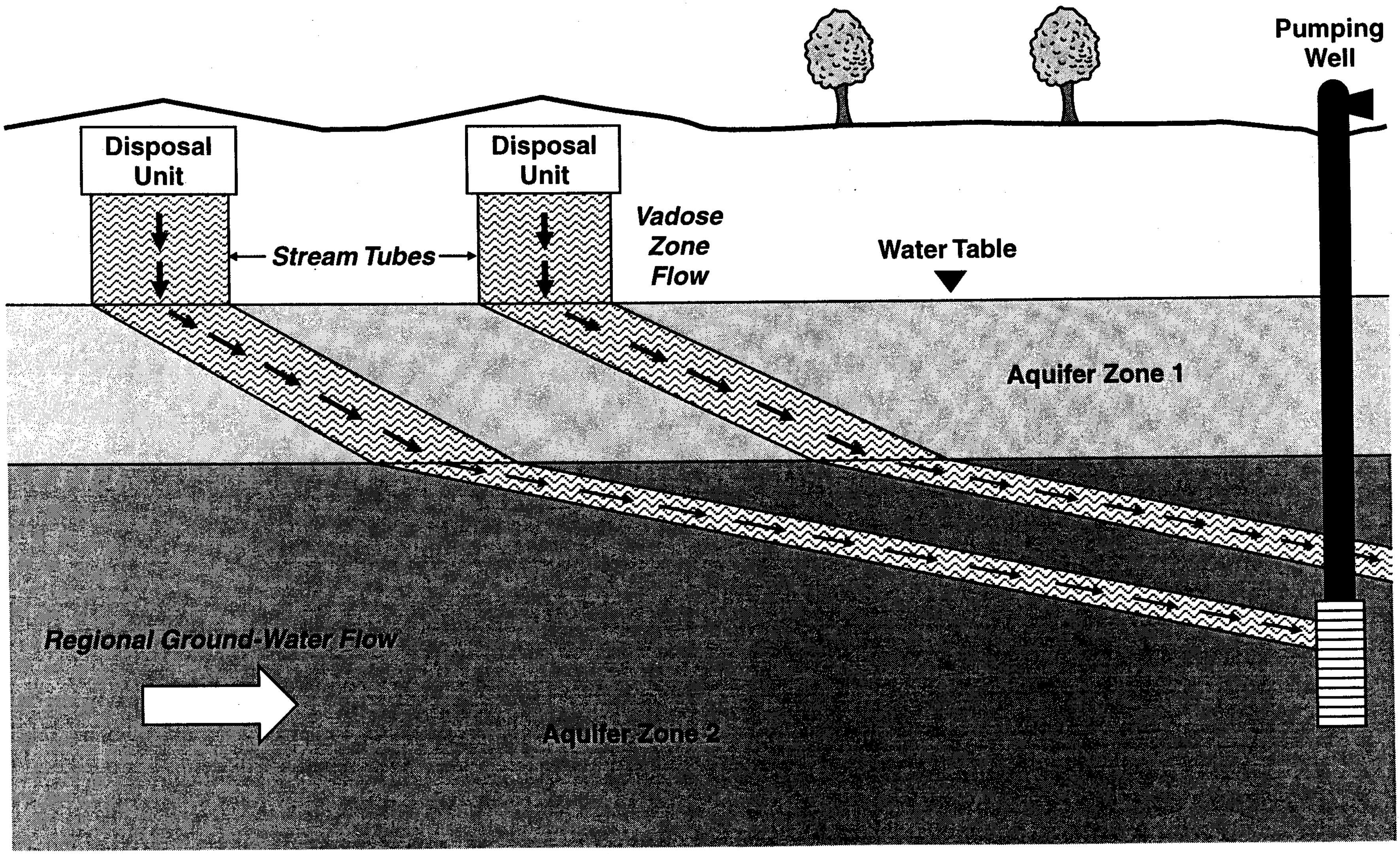

Pumping
Well
Disposal
Unit
Disposal
Unit
Vadose
Zone
Flow
Stream Tubes
Water Table
Aquifer Zone 1
Regional Ground-Water Flow
Aquifer Zone 2

FIG 11

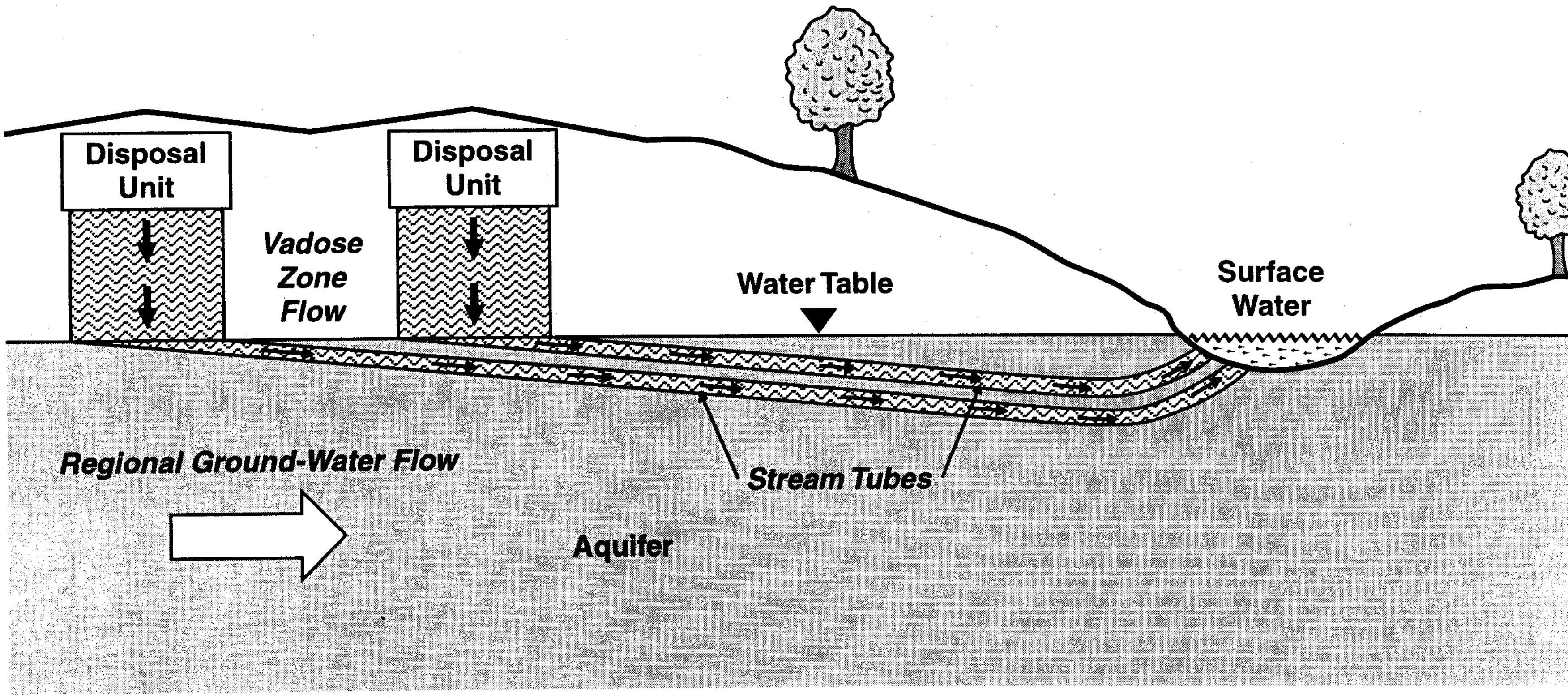

Disposal Unit
Disposal Unit
Vadose Zone Flow
Water Table
Surface Water
Regional Ground-Water Flow
Stream Tubes
Aquifer

Fig 12

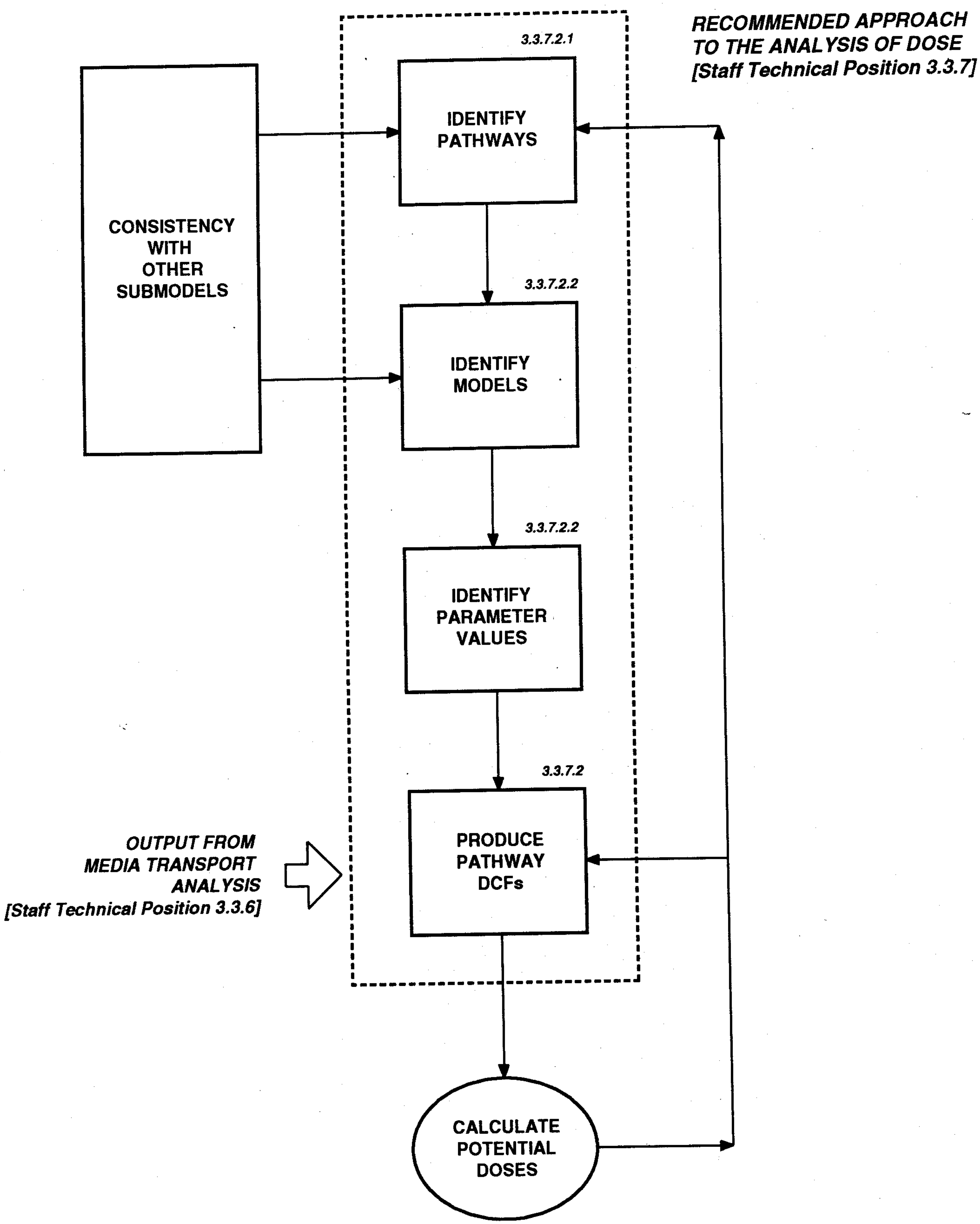

RECOMMENDED APPROACH
TO THE ANALYSIS OF DOSE
[Staff Technical Position 3.3.7]
CONSISTENCY
WITH
OTHER
SUBMODELS
3.3.7.2.1
IDENTIFY
PATHWAYS
3.3.7.2.2
IDENTIFY
MODELS
3.3.7.2.2
IDENTIFY
PARAMETER
VALUES
3.3.7.2
PRODUCE
PATHWAY
DCFs
OUTPUT FROM
MEDIA TRANSPORT
ANALYSIS
[Staff Technical Position 3.3.6]
CALCULATE
POTENTIAL
DOSES

FIG 13

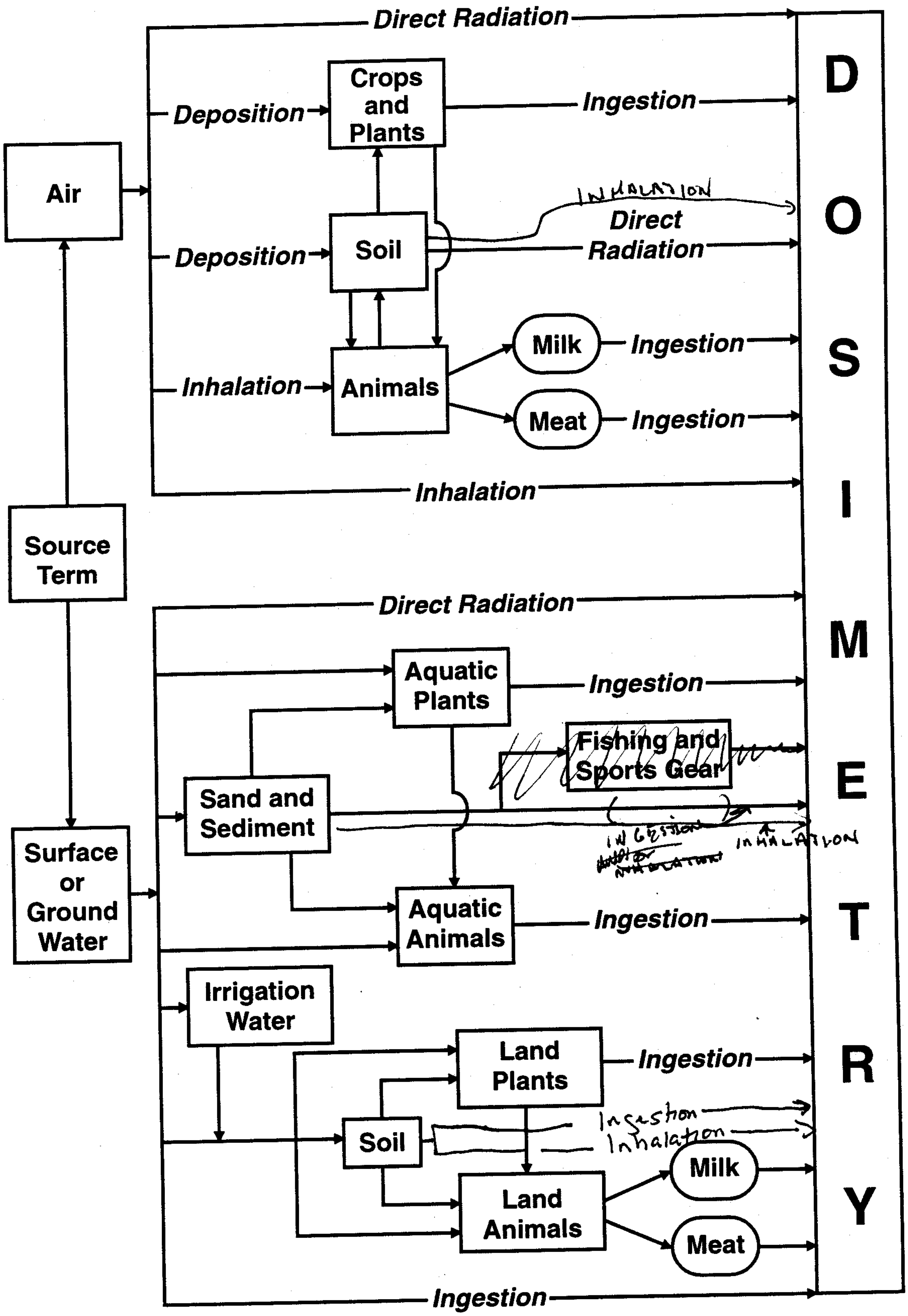

Direct Radiation
Air
Deposition
Crops and Plants
Ingestion
Deposition
Soil
INHALATION
Direct Radiation
Inhalation
Animals
Milk
Ingestion
Meat
Ingestion
Inhalation
D
O
S
I
M
E
T
R
Y
Source Term
Direct Radiation
Aquatic Plants
Ingestion
Fishing and Sports Gear
Sand and Sediment
INGESTION
INHALATION
Surface or Ground Water
Aquatic Animals
Ingestion
Irrigation Water
Land Plants
Ingestion
Soil
Ingestion
Inhalation
Milk
Land Animals
Meat
Ingestion

FIG 14

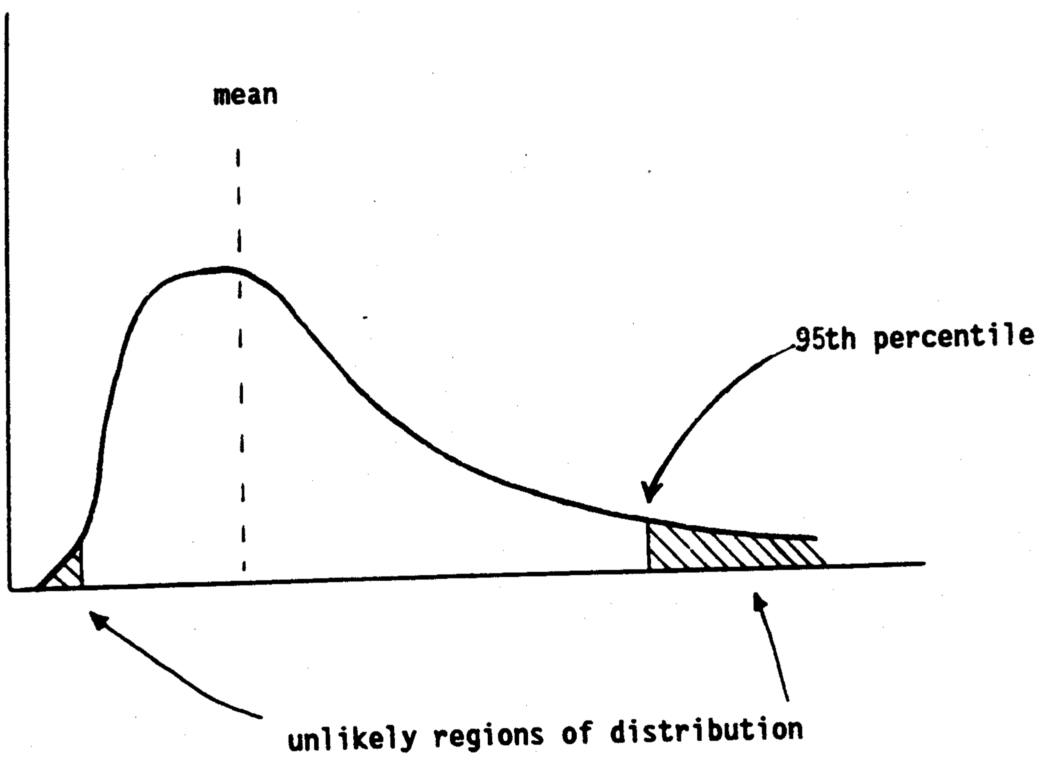
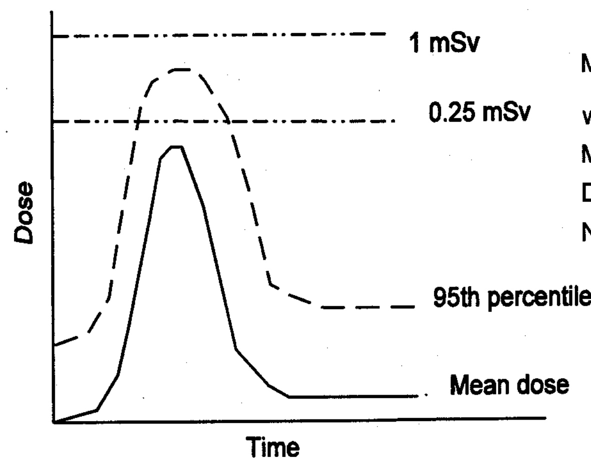


Figure B-1. Hypothetical distribution of results from uncertainty analysis showing mean and 95th percentile of distribution.

Proposed Approach



$$\text{Mean}(t) = \frac{\sum_{k=1}^{N} \text{Dose}_k}{N}$$

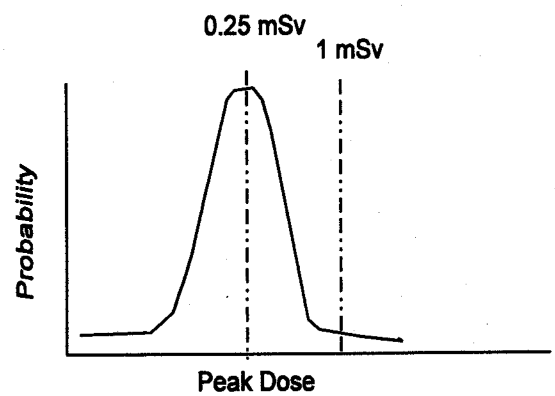
where:

Mean(t) ≡ mean dose at time t

$\text{Dose}_k(t)$ ≡ dose for run k, at time t

N ≡ total number runs

Previous Approach



$$\text{Mean} = \frac{\sum_{k=1}^{N} \text{Peak}(k)}{N}$$

where:

Mean ≡ mean peak dose

Peak(k) ≡ peak dose for run k

N ≡ number of runs

Figure B-2 Staff Recommended Approach to Calculating the Peak of the Mean Dose.