Heritage Minerals

MINERAL COMPOSITION

Economic Minerals	Waste Minerals
~90% ← Ilmenite ($TiO_2.FeO$)	Silica (SiO_2)
Leucoxene ($TiO_2.Fe_2O_3$)	Kyanite (Al_2SiO_5)
Rutile (TiO_2)	Sillimanite (Al_2SiO_5)
Zircon ($Zr\ SiO_4$)	Staurolite (Al, Fe.SiO_3)
Monazite (Ca, La, Y, Th.PO_4)	Tourmaline (Al, Fe, B, .SiO_3)

monazite. A phosphate of the cerium metals and the principal ore of the rare earths and thorium. Monoclinic. One of the chief sources of thorium used in the manufacture of gas mantles. It is a moderately to strongly radioactive mineral, $(CE,La,Y,Th)(PO_4)$; yellowish, reddish-brown, yellowish-brown, and green. It occurs widely disseminated as an accessory mineral in granitic igneous rocks and gneissic metamorphic rocks. Detrital sands in regions of such rocks may contain commercial quantities of monazite. It also occurs in pegmatites associated with zircon, xenotime, gadolinite, samarskite, fergusonite, magnetite, apatite, columbite, and ilmenite. Thorium-free monazite is rare. *Crosby, pp. 30-31; Fay; Dana 17.*

monazite sand. *See* monazite. *Bennett 2d, 1962.*

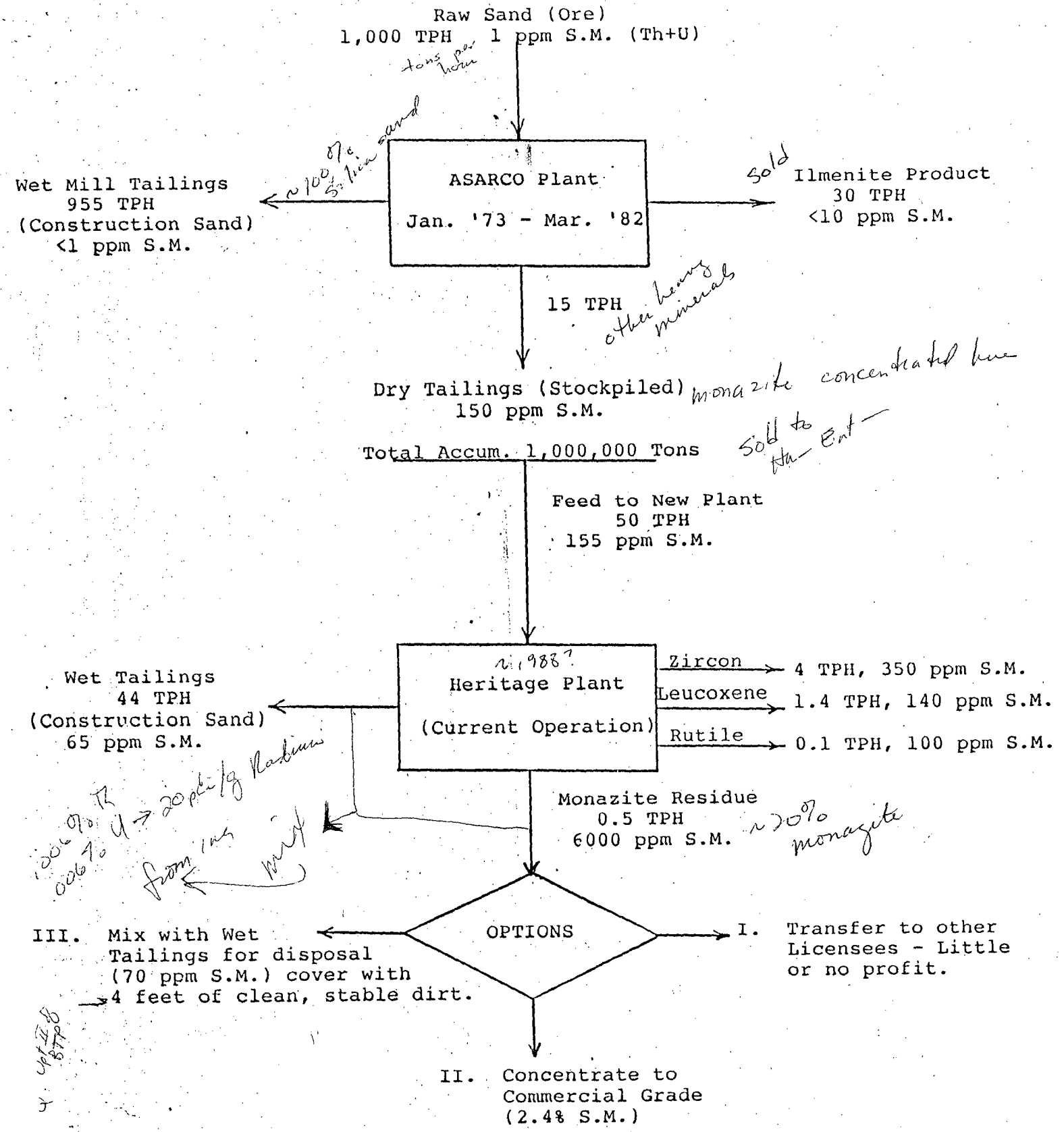


FIGURE I

PROJECT OVERVIEW

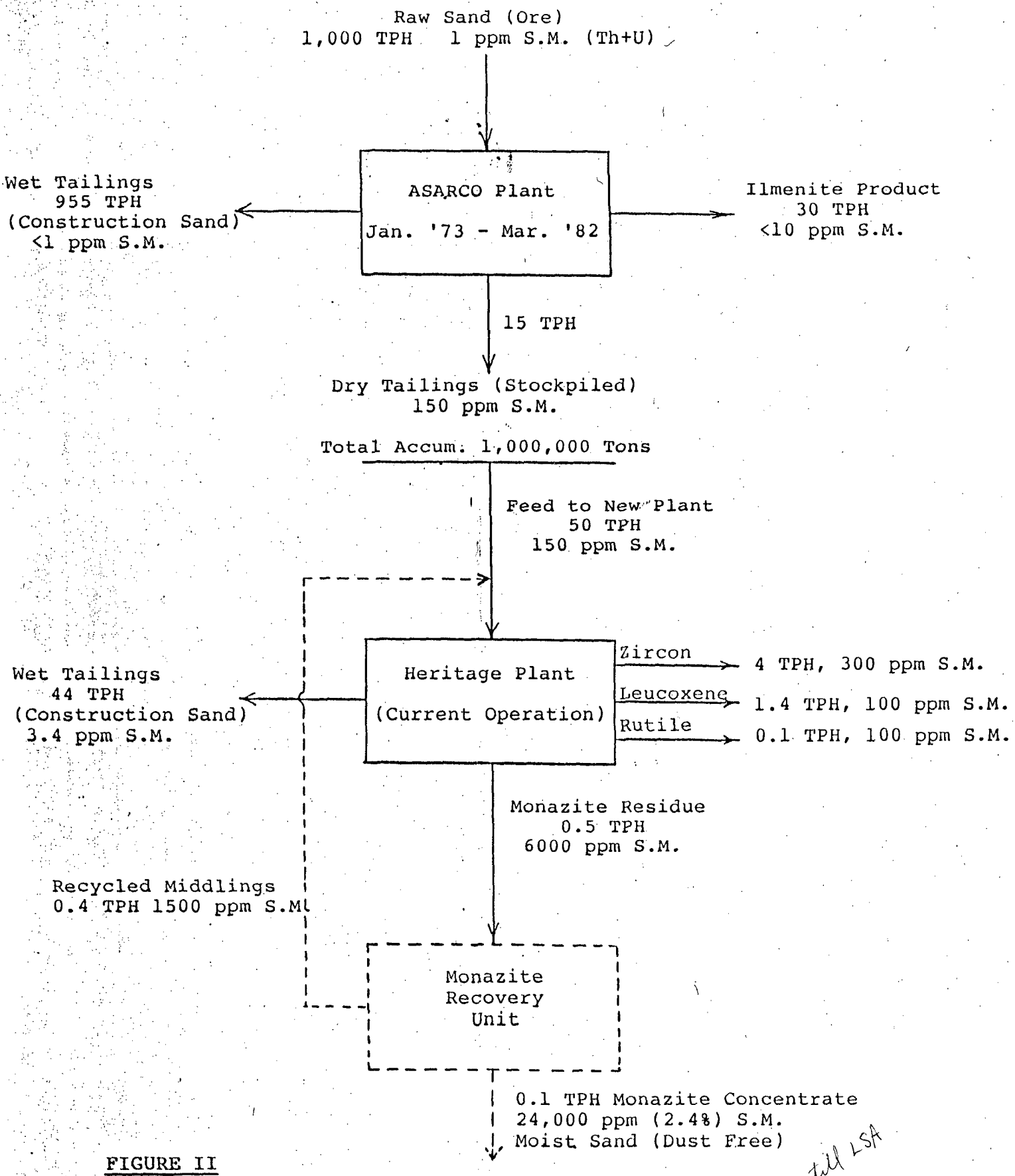


FIGURE II

MONAZITE PRODUCTION OPTION

still LSA

SEPARATION TECHNOLOGY

I. GRAVITY SEPARATION:

Based on differences in specific gravities between the minerals being separated.

Silica Sand Specific Gravity 2.65
Monazite Specific Gravity 5.2

$$\text{Separation Criteria} = \frac{5.2 - 1}{2.65 - 1} = 2.55$$

Therefore, separation of silica from monazite by gravity methods (spirals and tables) can be done effectively down to the finest sand (-200 mesh).

The wet mill tailings are expected to contain little or no monazite.

II. HIGH TENSION SEPARATION:

Based on differences in surface electrical conductivity between the minerals being separated.

Ilmenite, Leucoxene & Rutile	Conductors
Monazite (and zircon)	Nonconductors

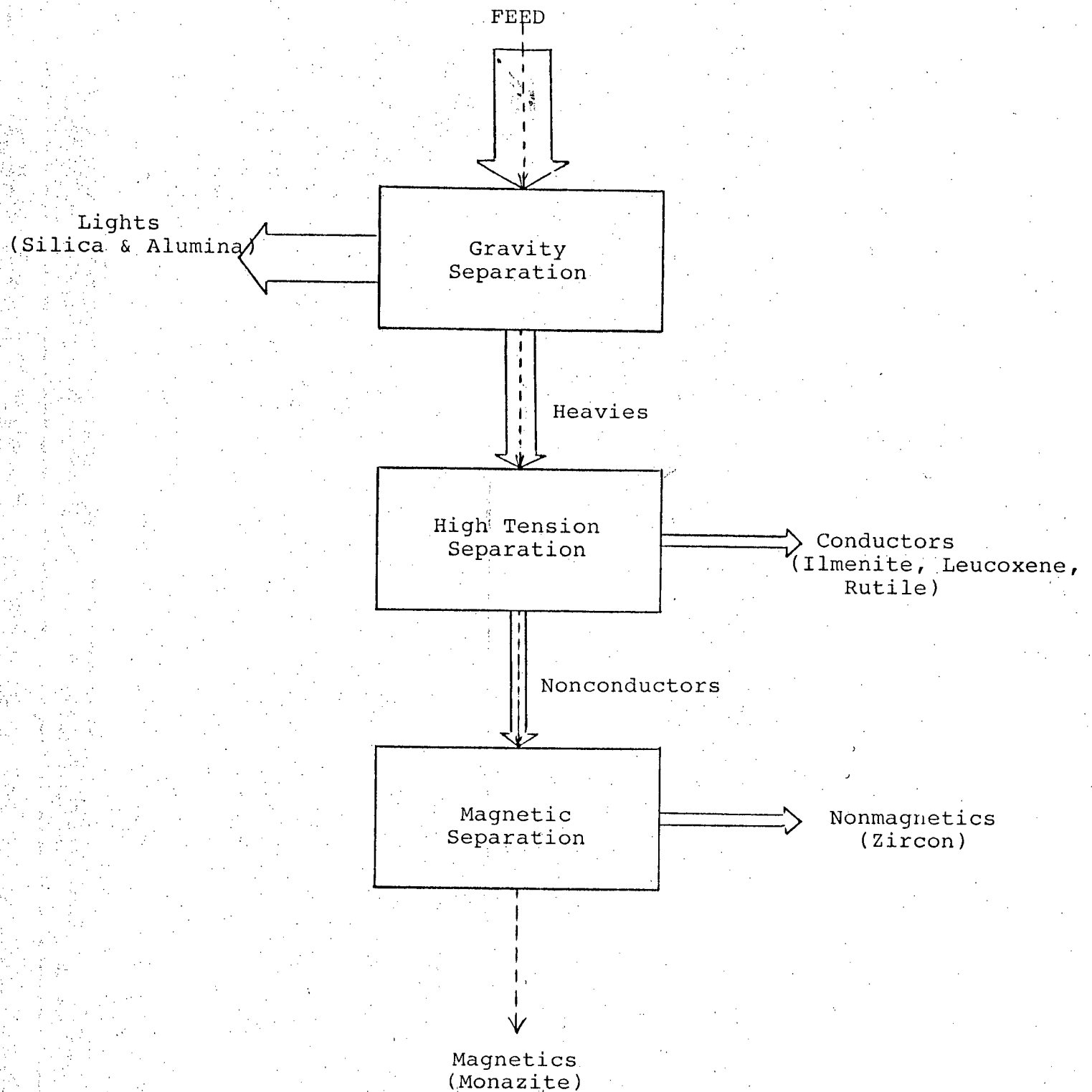
Therefore, no monazite is expected in the ilmentite, leucoxene or rutile products.

III. MAGNETIC SEPARATION:

Based on magnetic susceptibility differences between the minerals being separated.

Zircon	Nonmagnetic
Monazite	Magnetic

Therefore, no monazite is expected in the zircon product.



FATE OF SOURCE MATERIAL

IN PLANT OPERATIONS

POTENTIAL CUSTOMERS FOR MONAZITE

NAME	BUSINESS
Associated Minerals (Australia) not an end user but re-sells	Produces and markets mineral sands worldwide. Has major operations in Green Cove Springs, Florida. ← partner separation
Rhone Poulenc (France)	Ships monazite to France for processing into various products (TV Tubes, pigments, etc.) Has major rare earth chemical plant in Freeport, Texas.
Davison Chemical Division of Grace & Co. (Baltimore, MD)	Makes Catalysts for petroleum refining in Chattanooga, Tennessee.

CONCENTRATION OF SOURCE MATERIAL IN PLANT TAILINGS COMPOSITES

→ monazite mixed with wet tailings

Source	Conc., pci/g Th	Conc., pci/g U
Low Composite	6.3	5.7
Medium Composite	19.6	12.3
High Composite	29.4	23.6

composite refers to [illegible] conc of Th/U

Done γ-spec

2000' x 2000' (~100 acres)

From Technical Position radium is controlling factor 5 pCi Ra-226/Ra-228

10 pCi U = 5 U-234 + 5 U-238 ← assumes equilibrium

SUMMARY OF MAXIMUM CONCENTRATIONS PERMITTED UNDER DISPOSAL OPTIONS

Kind of Material	Disposal Options			
	1 [1]	2 [2]	3 [3]	4 [4]
Natural Thorium (Th-232+Th-228) with daughters present and in equilibrium	10	50	----	500
Natural Uranium (U-238+U-234) with daughters present and in equilibrium	10	----	40	200
Depleted Uranium:				
*Soluble	35	100	----	1,000
*Insoluble	35	300	----	3,000
Enriched Uranium:				
*Soluble	30	100	----	1,000
*Insoluble	30	250	----	2,500

[1] Based on EPA cleanup standards.

[2] Concentrations based on limiting individual doses to 170 mrem/yr.

[3] Concentration based on limiting equivalent exposure to 0.02 working level or less.

[4] Concentrations based on limiting individual doses to 500 mrem/yr and, in case of natural uranium, limiting exposure to 0.02 working level or less.

if downgrade necessary (Fig II)

OPTIONS FOR TAILINGS DISPOSAL

1. Sale for construction sand.
2. Cover with top soil and plant grass and other vegetation.
3. Pump to bottom of recreational lake.
4. Include in housing project plans.

HERITAGE'S FUTURE PLAN

1. Recycle material that contains economic concentrations of monazite, zircon and titanium to extract those values.

2. Deposit the clean sand in a separate site for use in fill or construction.

3. Continue to survey and sample the area as recycling progresses.

4. When sampling results in no more economic mineral values and the source material content is at acceptable levels, the entire property will be surveyed and decommissioned.

5. Decommissioning will be according to the requirements for Option I of the Branch Technical Position. That is, release of property for unrestricted use.

6. In the event that any remaining sand contains more Th or U than the Option I limits, but not sufficiently high to warrant recycling, Heritage may opt to cover this material with dirt or water (in the form of a recreational lake), thereby complying with Option II of the Branch Technical Position.