Heritage Minerals

MINERAL COMPOSITION

Economic Minerals	Waste Minerals
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.*

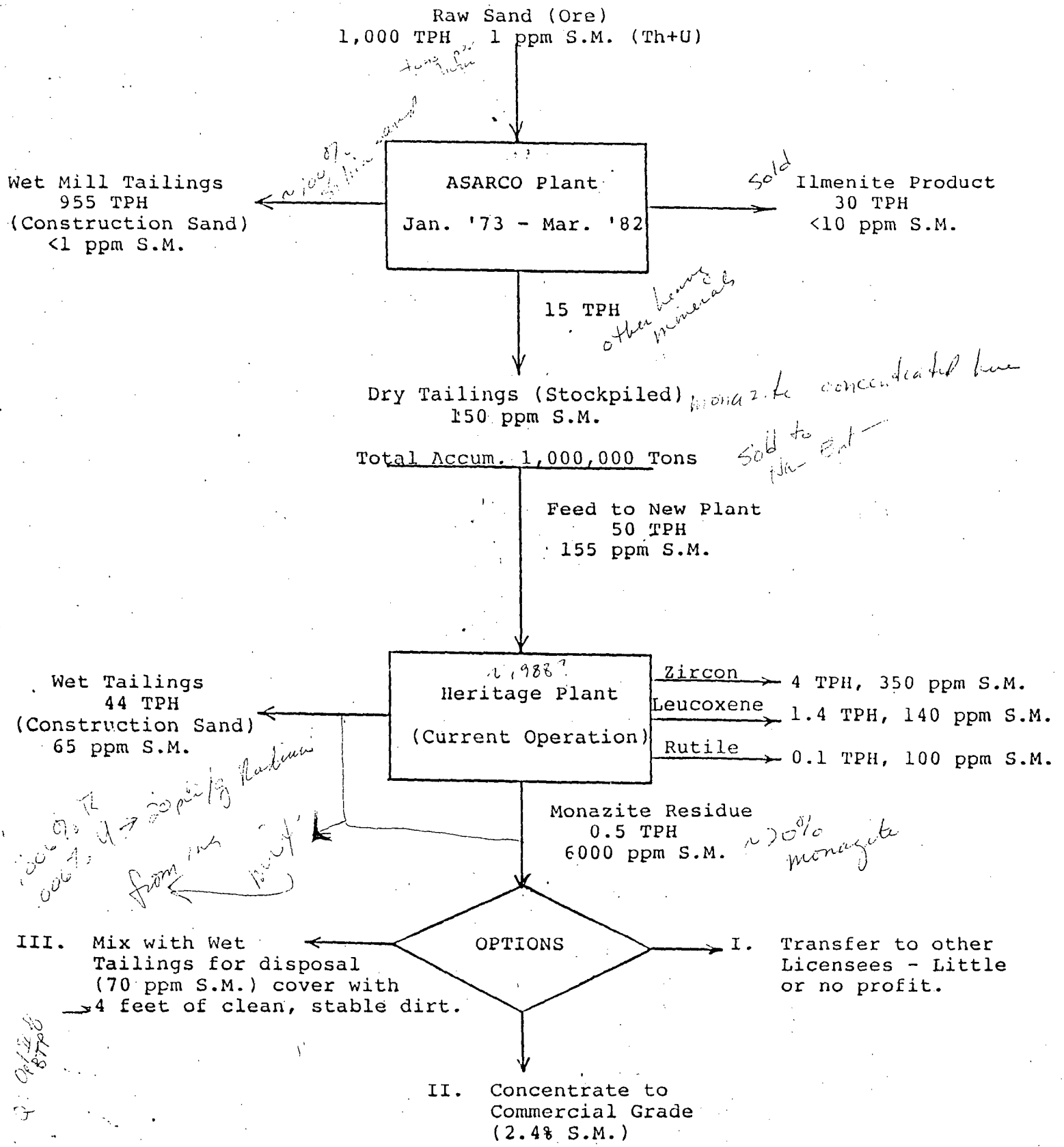


FIGURE I

PROJECT OVERVIEW

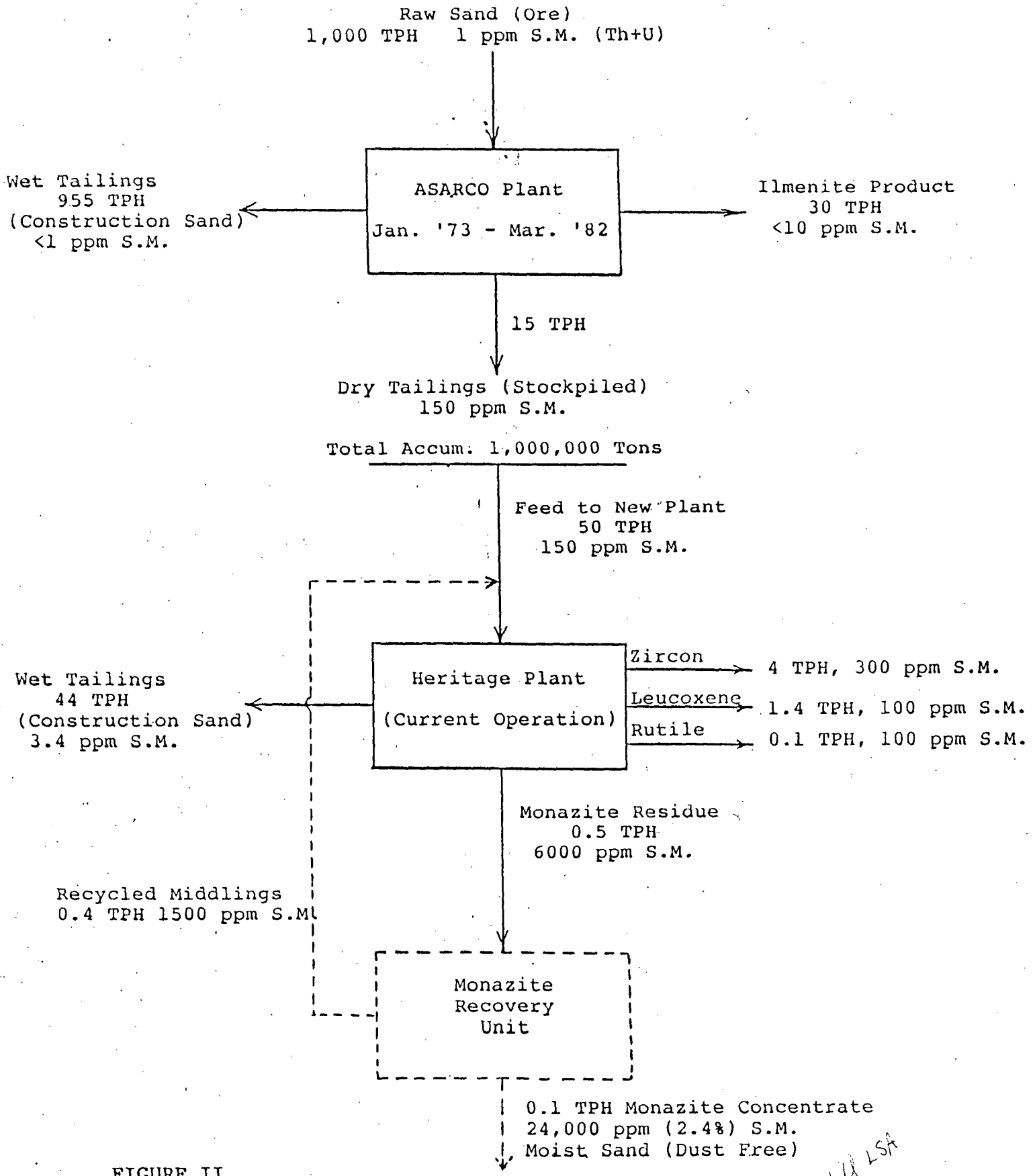


FIGURE II

MONAZITE PRODUCTION OPTION

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	Nonconductors

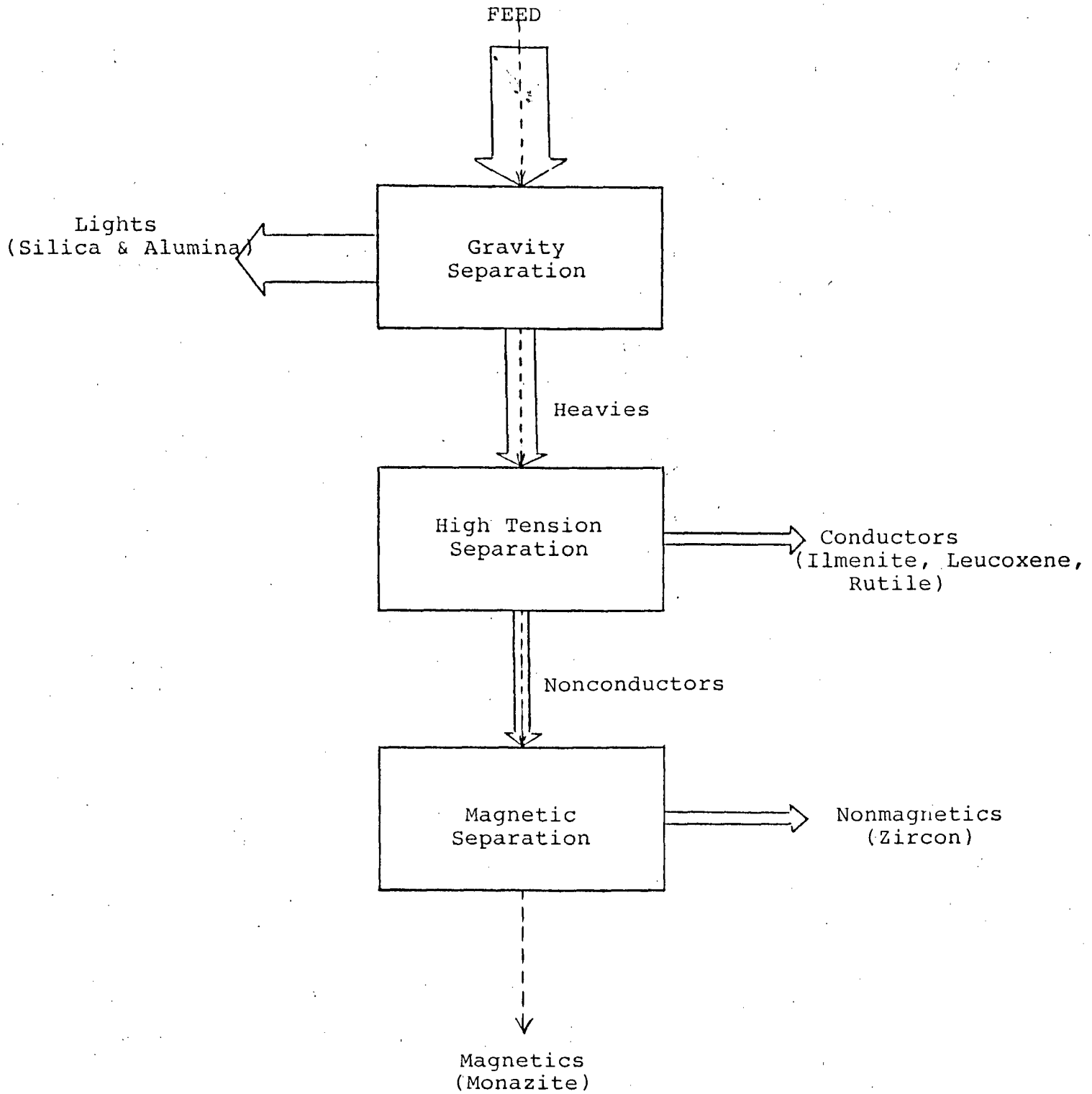
Therefore, no monazite is expected in the ilmentite, leucoxene or rutile products.

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. ← partial 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	U
Low Composite	6.3	5.7
Medium Composite	19.6	12.3
High Composite	29.4	23.6

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.

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.

- What security / control reqts. are applicable to this site? (Regs, etc.)

- What impact will new part 20 limits for dose to the public have on the site (100 vs. 500 mR/yr.)?

$$(30\,\mu R/hr)\left(\frac{mR}{10^3\,\mu R}\right)\left(\frac{24\,hr.}{d}\right)\left(\frac{365\,d}{yr}\right)$$

- Are we doing an Environmental Assessment of WNI's plan to "disperse by mixing" w/ other materials onsite, as requested by N.S.?

$$\left(100\ mR/yr\right)\left(\frac{yr}{8760\,hr}\right)\left(\frac{10^3\,\mu R}{mR}\right) =$$

$$\frac{10,000 \times 10^1}{8,760}$$

11.4 μR/hr

$$\frac{2.63 \times 10^5}{10^3} =$$

263 mR/yr.

$$\frac{1.14\ \mu R\text{-}yr}{mR\text{-}hr.}$$

$$8760 \overline{)\,10,000.00}\quad 1.14$$

8760

12300

8760

3540