THE SHOLO MILL:

Return on Investment versus Mill Design

by Hugh W. Reynolds
and Charles J. Gatchell

U.S.D.A. FOREST SERVICE RESEARCH PAPER NE-187
1971

NORTHEASTERN FOREST EXPERIMENT STATION, UPPER DARBY, PA.
FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE
WARREN T. DOOLITTLE, DIRECTOR

The Authors

HUGH W. REYNOLDS was graduated from the University of Minnesota in 1950 with a bachelor's degree in electrical engineering. His engineering experience included work in mining, heavy equipment manufacturing, and design of specialized research equipment. He did research work in drying of softwoods on the West Coast and served with the drying group at the USDA Forest Products Laboratory in Madison, Wisconsin. For the last 5 years he has been working in the hardwood product improvement project at the USDA Forest Products Marketing Laboratory of the Northeastern Forest Experiment Station at Princeton, West Virginia, in the utilization of low-grade hardwoods.

CHARLES J. GATCHELL received his bachelor of science degree in forestry from the University of Massachusetts in 1955. After a tour of duty with the U. S. Navy, he went to the New York State University College of Forestry at Syracuse University where in 1961 he received his master of science degree in wood-products engineering. From 1961 to 1965 he was a project scientist in the product and process development project at the USDA Forest Products Laboratory in Madison, Wisconsin. He is now project leader of the hardwood product improvement project at the USDA Forest Products Marketing Laboratory of the Northeastern Forest Experiment Station at Princeton, West Virginia.

MANUSCRIPT RECEIVED FOR PUBLICATION 12 AUGUST 1970.

BUILD A SHOLO MILL?

THE newly developed SHOLO (from SHOrt LOg) process can be used to convert low-grade hardwood logs into parts for standard warehouse pallets and pulp chips. Should you build a SHOLO mill? This paper has been prepared to help you decide.

A detailed description of the SHOLO process and the manpower and equipment needed for one type of SHOLO mill design are given in an earlier paper (*The SHOLO mill: make pallet parts and pulp chips from low-grade hardwoods,* by Hugh W. Reynolds and Charles J. Gatchell; USDA Forest Service Research Paper NE-180, 1970).

Whether you decide to build a SHOLO mill will depend on whether it would be profitable enough. How will changes in such factors as timber quality and quantity, labor supply, interest rates, and prices for pallet parts and pulp chips affect your profits? Will changes in mill design make the process more worthwhile? A return-on-investment analysis will provide answers to questions such as these. Return on investment is the annual profit remaining after all expenses are paid; it is expressed as a percentage of the equity capital investment.

This paper presents an approach to determining return on investment for the independent producer — the businessman whose major concern is an adequate profit. But we recognize that there may be other reasons for investing in a SHOLO mill. Consider the large timber holder who is converting low-quality hardwood stands into higher yielding softwood stands. This is normally done at an initial financial loss, with the expectation of greater profits in the future. The timber holder may find that the SHOLO mill would change his losses to a small profit and therefore would be worthwhile.

Consideration of the motives behind the potential investment is beyond the scope of this report. Whatever your reasons may be for considering a SHOLO mill, the procedures contained in this report will help you to make your decisions. By varying the values of your own unique set of factors and repeating the analysis, you will obtain an accurate picture of the range of profits that can be expected.

PROCEDURE FOR DETERMINING THE RETURN ON INVESTMENT

To illustrate the procedural steps in determining the return on investment, we based our examples on the SHOLO mill described in our earlier report. Before a determination can be started, twelve basic factors must be known or estimated:

	Item	*Example value*
1.	Daily pallet-part production rate	16 MBF
2.	Pallet-part selling price	$128/MBF
3.	Pulp-chip selling price	$7/ton
4.	Long-log potential[1]	57 percent
5.	SHOLO-log potential[2]	28 percent
6.	Number of employees and wage rates	20 men @ $2.50/hour 3 men @ $3.50/hour
7.	Total capital investment	$550,000
8.	Equity capital	$300,000
9.	Borrowed capital	$250,000
10.	Depreciation schedule	Straight line
11.	Interest rates:	
	a. Borrowed capital	8 percent
	b. Sinking fund	6 percent
12.	Percentage of income for operations[3]	20 percent

[1]Long-log potential $= \dfrac{\text{Weight of SHOLO logs}}{\text{Weight of representative sample of long logs}} \times 100$

[2]SHOLO-log potential $= \dfrac{\text{Weight of pallet parts}}{\text{Weight of representative sample of SHOLO logs}} \times 100$

[3]Money based on the percentage of income for operations is used to cover such items as employee fringe benefits, electric power, phone bills, and other overhead items. It will cover all expenses not specifically listed on worksheet 1,

The long-log potential and the SHOLO-log potential should be determined from pilot-plant tests of representative samples of raw material.

There are many ways to make financial plans for building a SHOLO mill. In our example we have assumed that:

- The total capital investment ($550,000) will be made up in part by owner's equity ($300,000); the remainder will be borrowed capital ($250,000).
- The land on which the mill is built will not depreciate and will be used as collateral for a loan ($20,000) to cover its purchase price. The only cost of the land will be the interest (8 percent) on this loan.
- The life of the plant will be 10 years, at the end of which there is no salvage value.
- The depreciation schedule is straight line.
- The borrowed capital ($250,000) will be raised by the sale of a bond at 8 percent interest, maturing in 10 years.
- A 10-year sinking fund will be established to accumulate the money to retire the bond ($250,000) and pay back the owner's equity ($300,000). As this money is really a form of savings, it will earn interest (6 percent) that will be used to reduce the principal payments to the sinking fund.
- The return on investment will be the annual profit that the owner will receive for the use of his equity capital ($300,000).

THE NOMOGRAM CHARTS

We have devised a set of nomogram charts that you can use to determine the values you will need to know. The nomogram consists of three scales. Plot the two known values on their respective scales; lay a straightedge across them; and the point where the straightedge crosses the third scale will give you the unknown value you need.

Though the nomogram is subject to estimation errors (you have to interpolate when the line falls between two marks on the scale), it is precise enough to allow an accurate evaluation of particular choices of SHOLO mill design and production and financial factors.

Normally, investors will start with what is for them the best combination of factors. Often it will be necessary to make adjustments in these factors to end up with a realistic combination. The use of the nomograms will enable the SHOLO mill designer and the prospective SHOLO mill owner to arrive at a common understanding. The owner will be interested in varying all factors to arrive at the best profit or return on investment. The designer will be interested in developing a well-balanced production operation that will satisfy the owner's profit requirements.

By visually showing the relationship between factors, nomograms help to avoid the necessity for repeated mathematical calculations and to focus on the factors themselves. When a set of acceptable factors is found that give the desired rate of return on investment, a more precise analysis by conventional accounting methods should be made.

A WORD OF CAUTION: Several of the nomograms are based on specific assumptions. If the assumptions are changed, these nomograms cannot be used with accuracy. For example, charts 1, 6, and 8 are based on 225 production-days per calendar year. Chart 2 is based on hardwood species that yield green pallet parts weighing 2 tons per MBF. If you wish to use different assumptions, calculate the values at that point and proceed on with the other nomograms.

CALCULATING THE RETURN ON INVESTMENT

The method for determining return on investment is given in a series of steps, one for each value factor. For each step, the nomogram to be used is on the left-hand page. On the facing page you will find: (1) the assumption on which the nomogram is based; (2) the procedure to be followed, given without reference to specific values; and (3) an example showing how the value is derived from the nomogram.

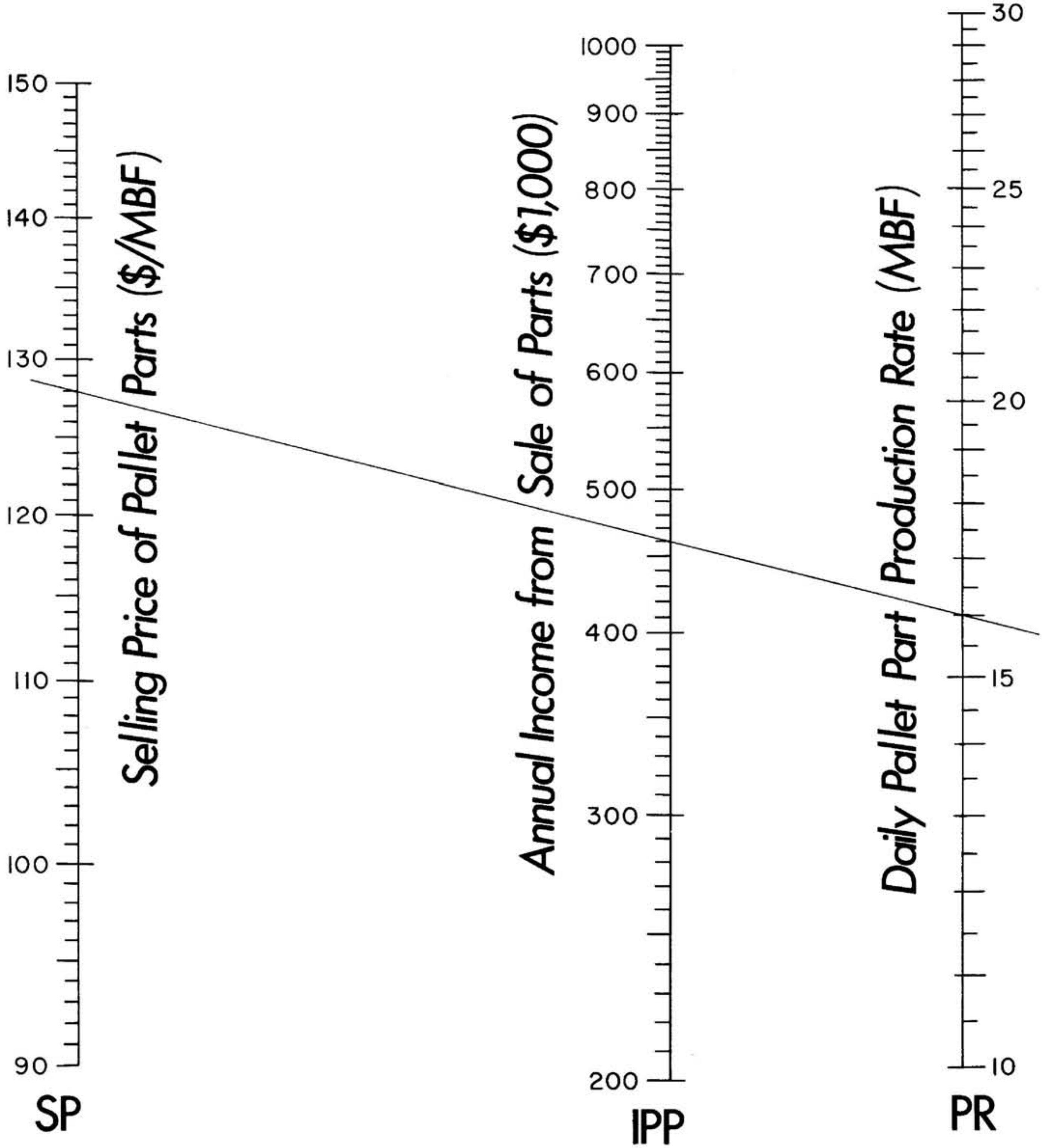
At the back of the book (page xx) is a fold-out sample worksheet that shows how the individual values can be recorded for calculating the return on investment. When the worksheet is folded out, you will have before you (1) the nomogram, (2) the page of instructions, and (3) the worksheet on which each value factor is entered for the example used.

Blank worksheets are attached that you can use for determining value factors for conditions other than those used in the examples.

CHART I

Annual Income from Sale of Pallet Parts for 225 Production Days Per Year

IPP = SP x 225 x PR x .001



STEP 1.
ANNUAL INCOME FROM SALE OF PALLET PARTS

Assumption: 225 production-days per year.

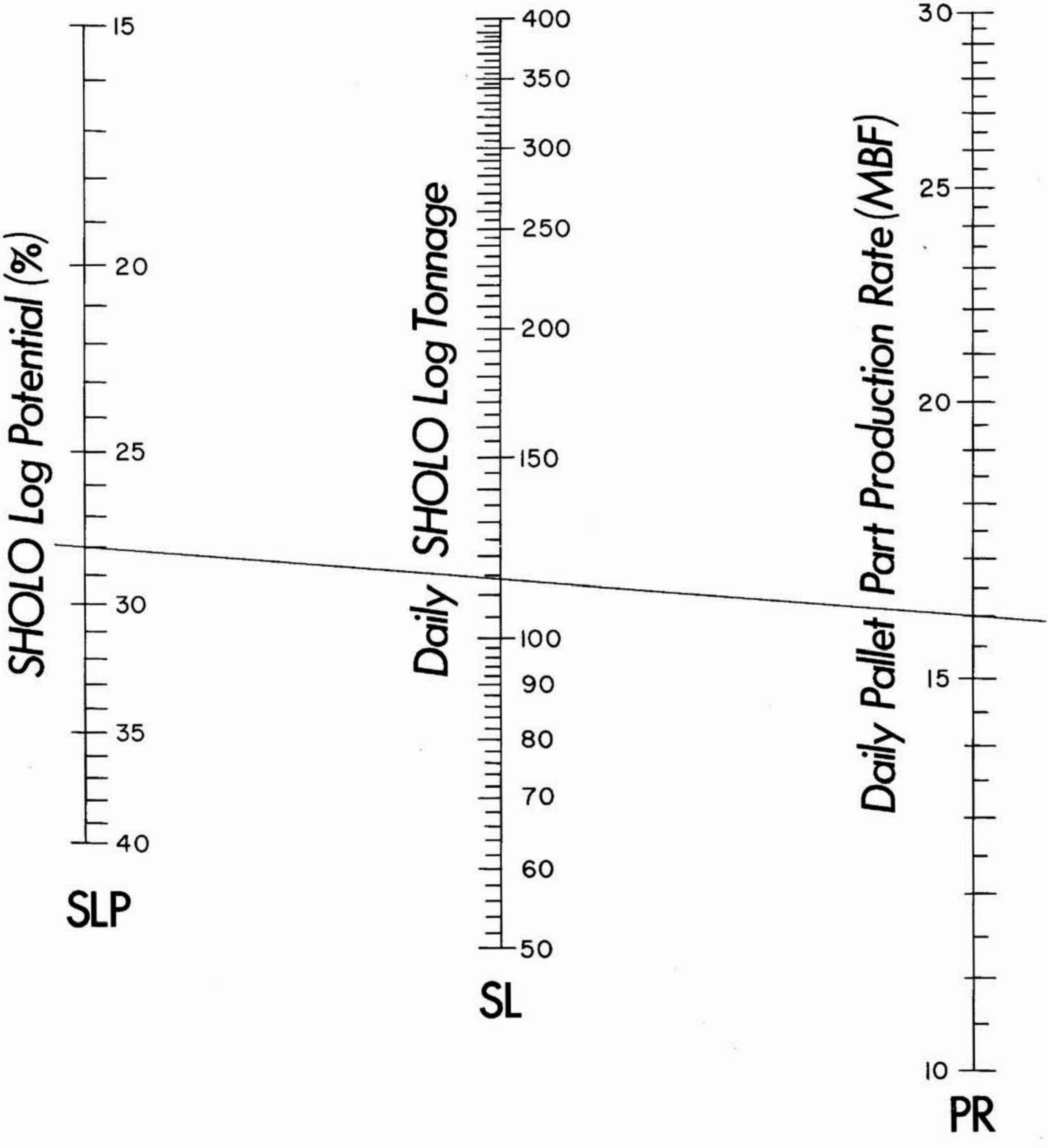
Procedure:

1. Decide on the required or desired daily pallet-part production rate in terms of MBF/day. Enter this value as item 1 on the worksheet.
2. Next decide on the required or desired selling price per MBF for the pallet parts. Enter this value as item 2 on the worksheet.
3. Using chart 1, mark the selling price (SP) of pallet parts on the SP scale. Mark the daily production rate (PR) value on the PR scale. With a straightedge connect these two marks. Read the income from the sale of parts where the line crosses the IPP scale. Enter this value as item 22 on the worksheet.
4. Proceed to step 2.

Example:

Daily pallet parts production rate is:	16 MBF
Selling price of finished green pallet part is:	$128/MBF
Annual income from the sale of pallet parts is read as:	$460,000

CHART 2
Daily Tonnage of SHOLO Logs for Pallet Parts Weighing 2 Tons/MBF
SL=200 PR/SLP



STEP 2.
DAILY TONNAGE OF SHOLO LOGS

Assumption: Green pallet parts weigh 2 tons per MBF. This is valid for such hardwoods as oaks, beech, pecan hickory, white ash, and sugar maple.

Procedure:

1. Enter the SHOLO-log potential as item 3 on the worksheet. Based on a representative sample of SHOLO logs, the SHOLO-log potential equals

$$\frac{\text{Total weight of pallet parts}}{\text{Total weight of SHOLO logs}} \times 100.$$

2. Using chart 2, mark the SHOLO-log potential on the SLP scale. Mark the daily pallet part production rate (item 1 on the worksheet) on the PR scale. With a straightedge connect these two marks. Read the required SHOLO-log quantity from the SL scale. Enter this value as item 4 on the worksheet.

3. Proceed to step 3.

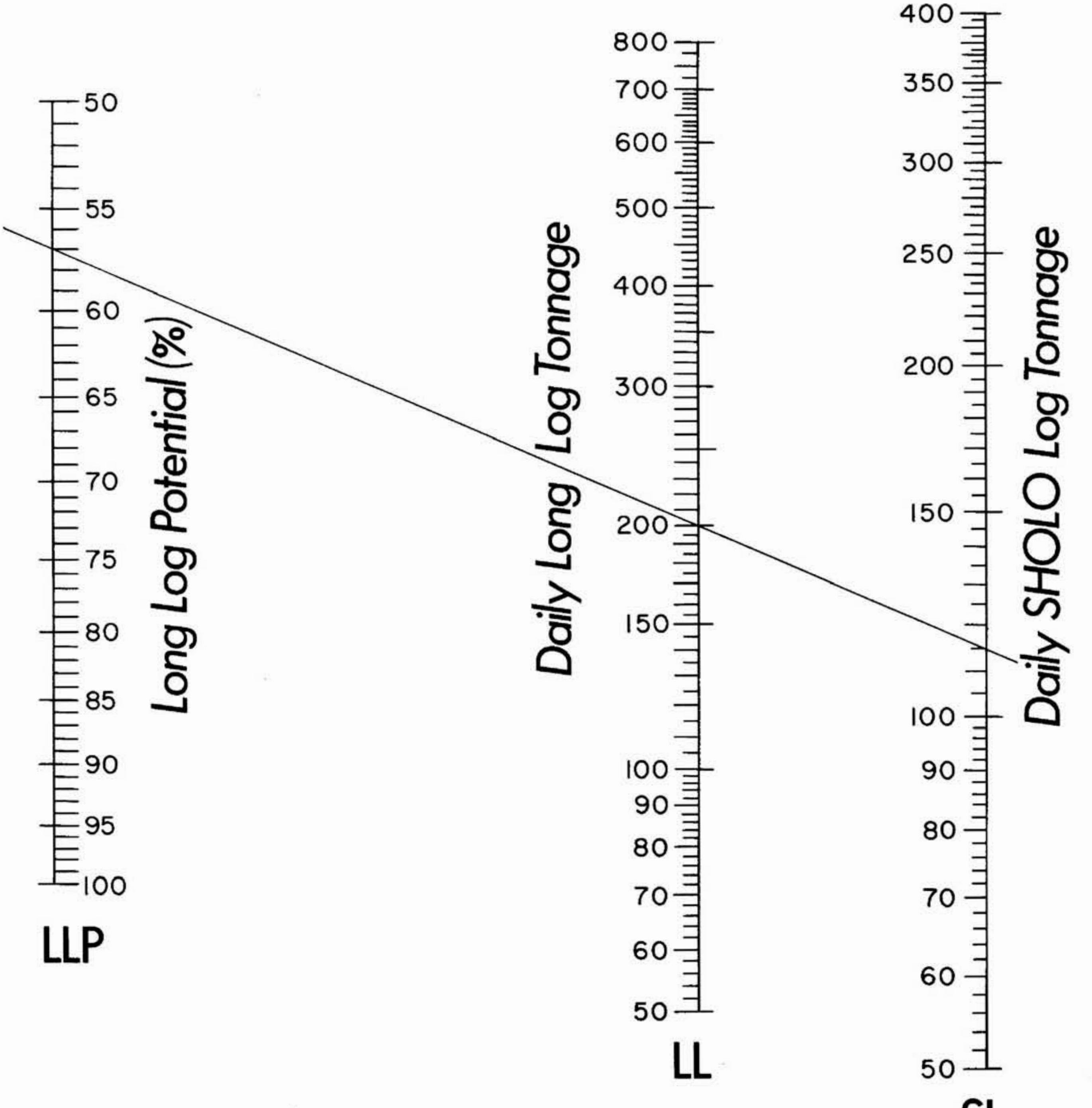
Example:

SHOLO-log potential is:	28 percent
Daily pallet-part production rate is:	16 MBF
Daily SHOLO-log tonnage is read as:	114 tons/day

CHART 3

Daily Long Log Tonnage

$$LL = \frac{SL \times 100}{LLP}$$



STEP 3.
DAILY LONG-LOG TONNAGE

Assumption: None.

Procedure:

1. Enter the long-log potential as item 5 on the worksheet. Based on a representative sample of long logs, the long-log potential equals

$$\frac{\text{Total weight of SHOLO logs}}{\text{Total weight of long logs}} \times 100.$$

2. Using chart 3, mark the long-log potential on the LLP scale. Mark the SHOLO log tonnage (item 4 on the worksheet) on the SL scale. With a straightedge connect these two marks. Read the required daily long-log tonnage from the LL scale. Enter this value as item 6 on the worksheet.

3. Proceed to step 4.

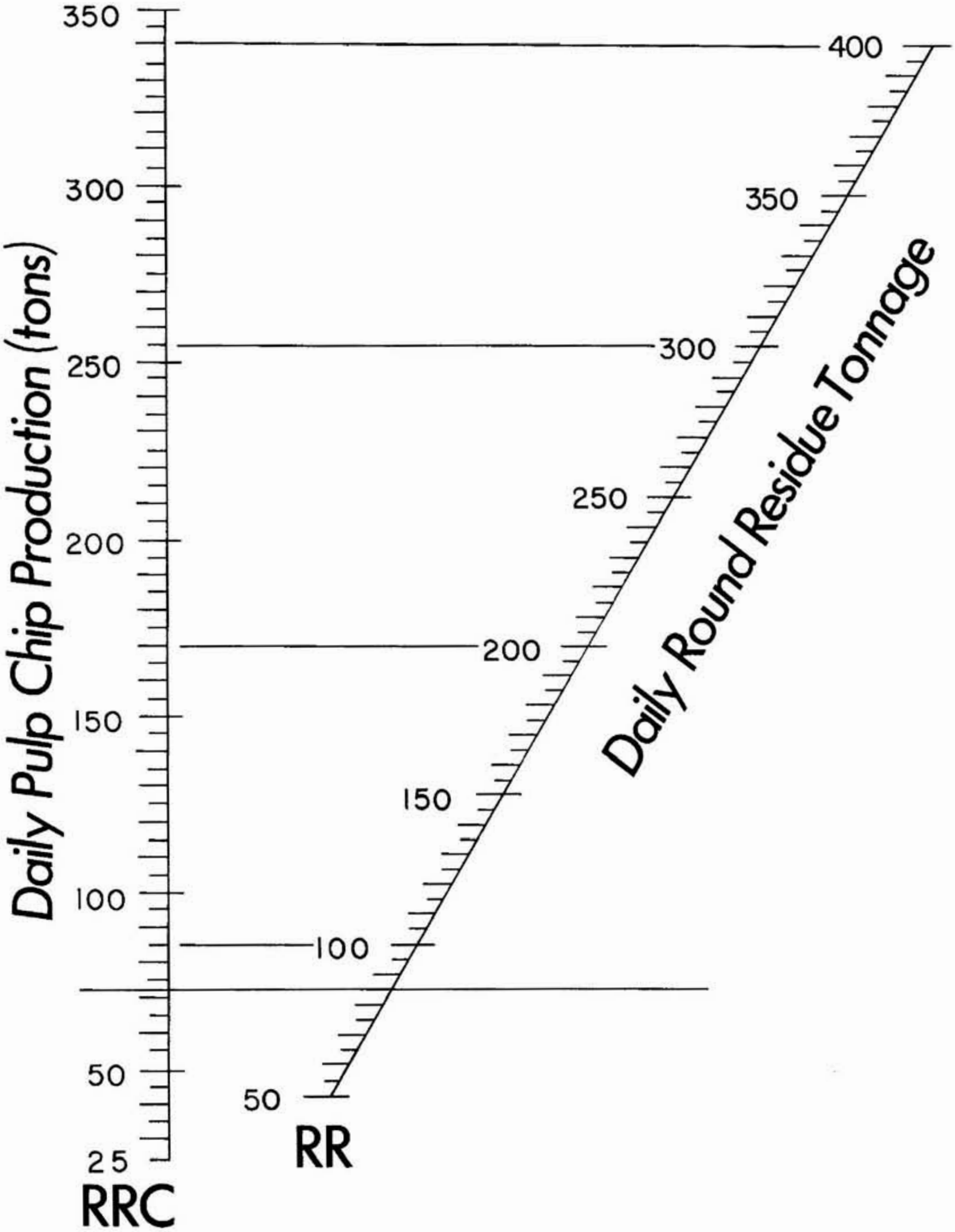
Example:

Long-log potential is:	57 percent
SHOLO-log tonnage is:	114 tons/day
Long-log tonnage is read as:	200 tons/day

CHART 4

Daily Pulp Chip Production from Round Residue for 85% Yield by Weight

RRC=0.85 RR



STEP 4.

DAILY PULP-CHIP PRODUCTION FROM ROUND RESIDUE

Assumption: The chipping of round residue yields 85 percent by weight of pulp chips and 15 percent by weight of waste.

Procedure:

1. Determine the daily tonnage of round residue by subtracting item 4 (SHOLO-log tonnage) from item 6 (long-log tonnage). Enter the daily round-residue tonnage as item 7.
2. Using chart 4, mark the round residue quantity on the RR scale. With a straightedge mark a horizontal line to the RRC scale. Enter the value read on the RRC scale as item 8 on the worksheet.
3. Proceed to step 5.

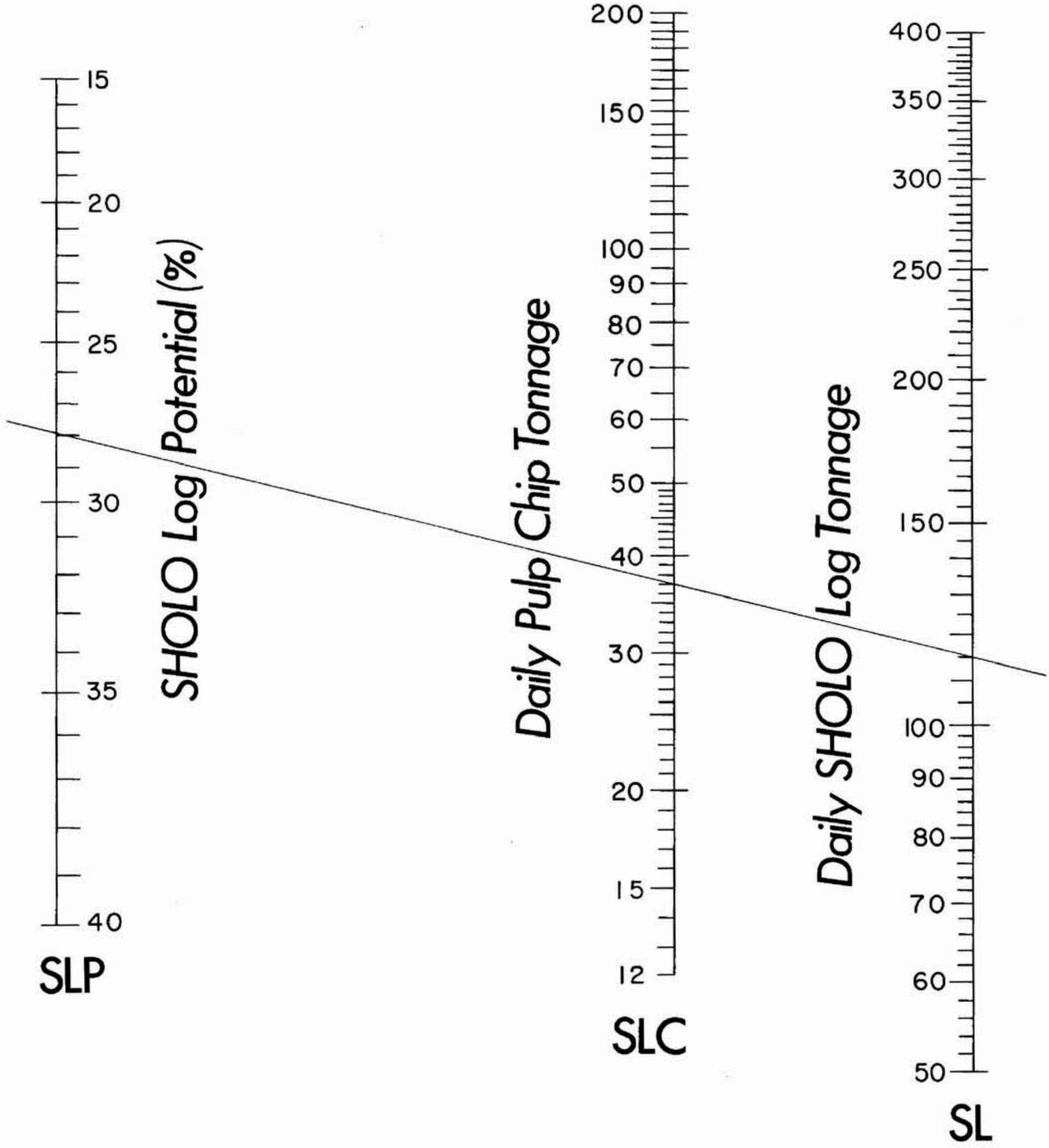
Example:

Long-log tonnage is:	200 tons/day
SHOLO-log tonnage is:	114 tons/day
Round-residue tonnage = 200 — 114 =	86 tons/day
Daily pulp-chip production is read as:	74 tons/day

CHART 5

Daily Pulp Chip Tonnage from SHOLO Log Residue

$$SLC = \frac{SL \times (60 - SLP)}{100}$$



STEP 5.
DAILY CHIP PRODUCTION FROM SHOLO-LOG RESIDUE

Assumption: Sixty percent of the weight of the SHOLO logs is convertible into finished pallet parts and pulp chips. The remaining 40 percent is attributed to bark, sawdust, planer shavings, and short-end trim pieces.

Procedure:

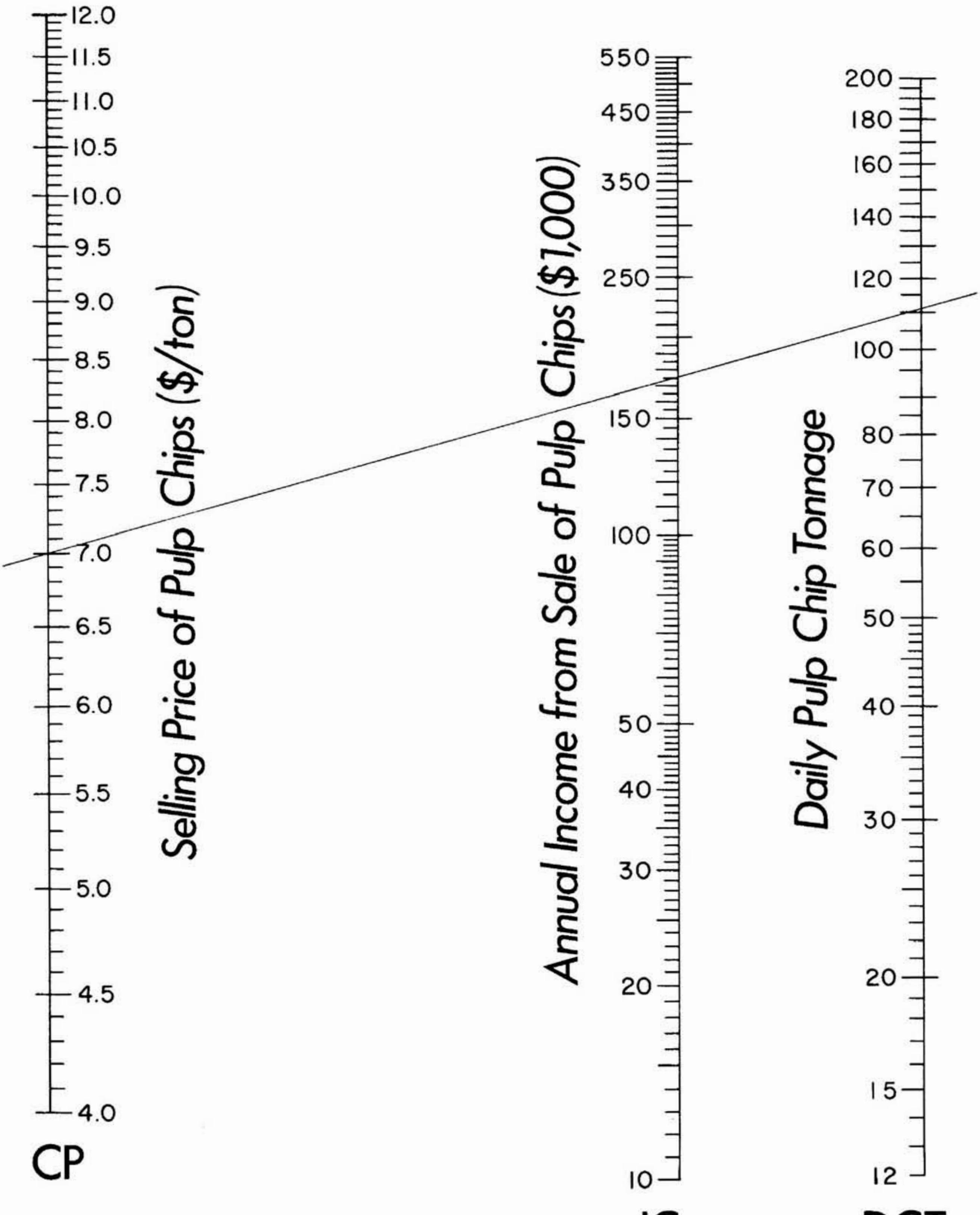
1. Using chart 5, mark the SHOLO-log potential (item 3) on the SLP scale. Mark the SHOLO-log tonnage (item 4) on the SL scale. With a straightedge connect these two marks. Read the daily pulp-chip tonnage from the SLC scale and enter this value as item 9 on the worksheet.
2. Proceed to step 6.

Example:

SHOLO-log potential is:	28 percent
SHOLO-log tonnage is:	114 tons/day
Chip production from SHOLO-log residue is read as:	37 tons/day

CHART 6

Annual Income from Sale of Pulp Chips for 225 Production Days per Year $IC = DCT \times 225 \times CP \times 0.001$



STEP 6.
ANNUAL INCOME FROM THE SALE OF PULP CHIPS

Assumption: 225 production-days per year.

Procedure:

1. Determine the total daily pulp-chip tonnage by adding item 8 (pulp chips from round residue) and item 9 (pulp chips from SHOLO logs). Enter this total as item 10.
2. Enter the selling price (f.o.b. the SHOLO mill) for green pulp chips as item 11 on the worksheet.
3. Using chart 6, mark the pulp-chip selling price (item 11) on the CP scale. Mark the total daily pulp-chip tonnage (item 10) on the DCT scale. Read the annual income from the sale of pulp chips on the IC scale and enter this value as item 23 on the worksheet.
4. Proceed to step 7.

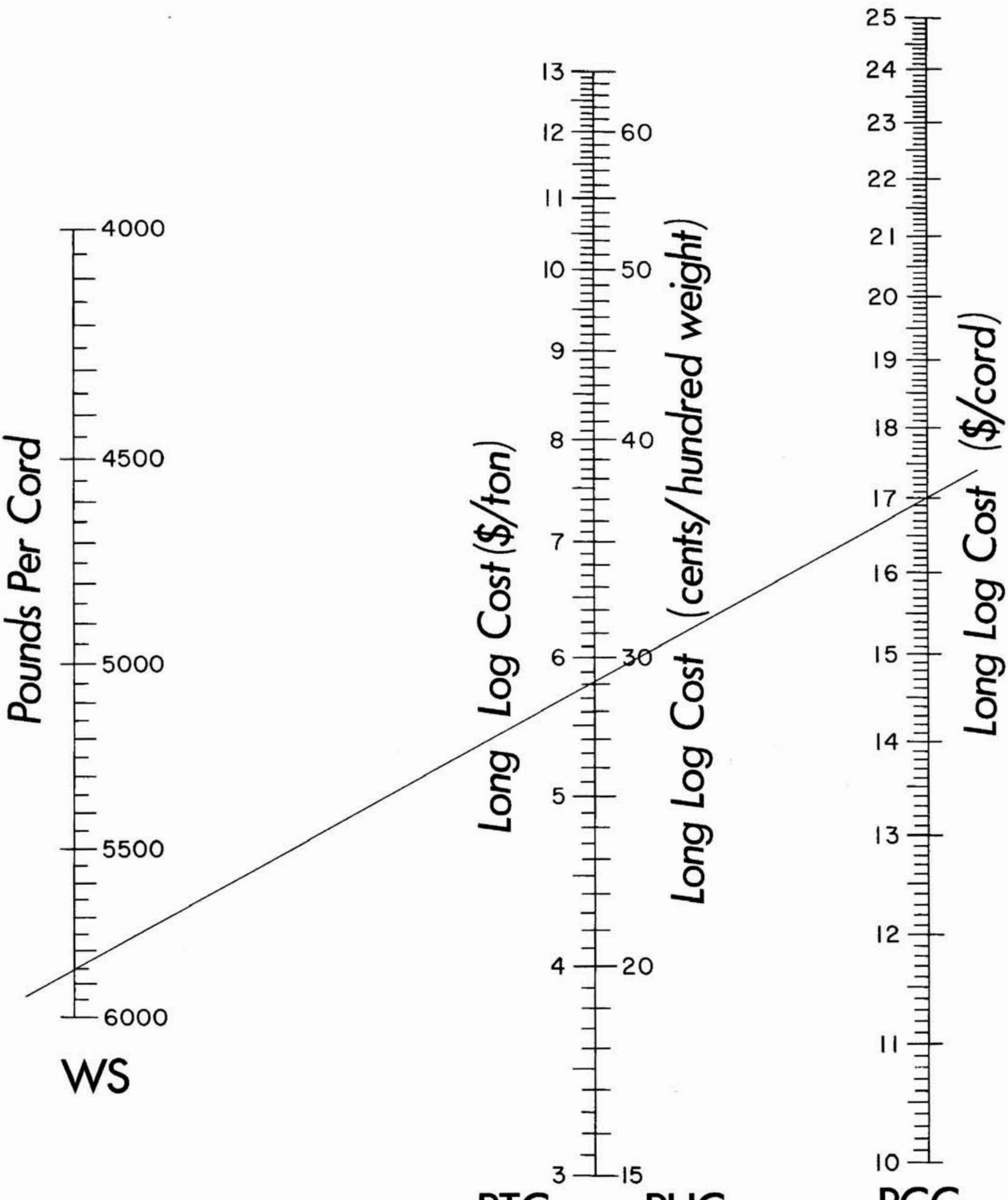
Example:

Pulp-chip selling price is:	\$7/ton
Pulp-chip yield from round residue is:	74 tons/day
Pulp-chip yield from SHOLO logs is:	37 tons/day
Total daily pulp-chip tonnage = 74 + 37 =	111 tons/day
The annual income from the sale of pulp chips is read as:	\$175,000

CHART 7

Long Log Cost Per Ton

PTC=PCC x 2000/WS



STEP 7.
LONG-LOG COST PER TON

Assumption: None.

Procedure:

1. When the long-log costs are stated in dollars per ton, enter this value as item 13 and proceed to step 8.
2. When log costs are stated in dollars per cord or dollars per hundredweight, proceed as follows:
   a. Dollars per cord: First, determine the weight scaling factor or how many pounds of long logs make a cord. Enter this as item 12 on the worksheet. Next, determine the long-log cost per cord. Using chart 7, mark the weight scaling factor on the WS scale. Enter the log cost per cord on the PCC scale. With a straightedge connect the two marks. Read the log cost per ton from the PTC scale. Enter this value as item 13 on the worksheet.

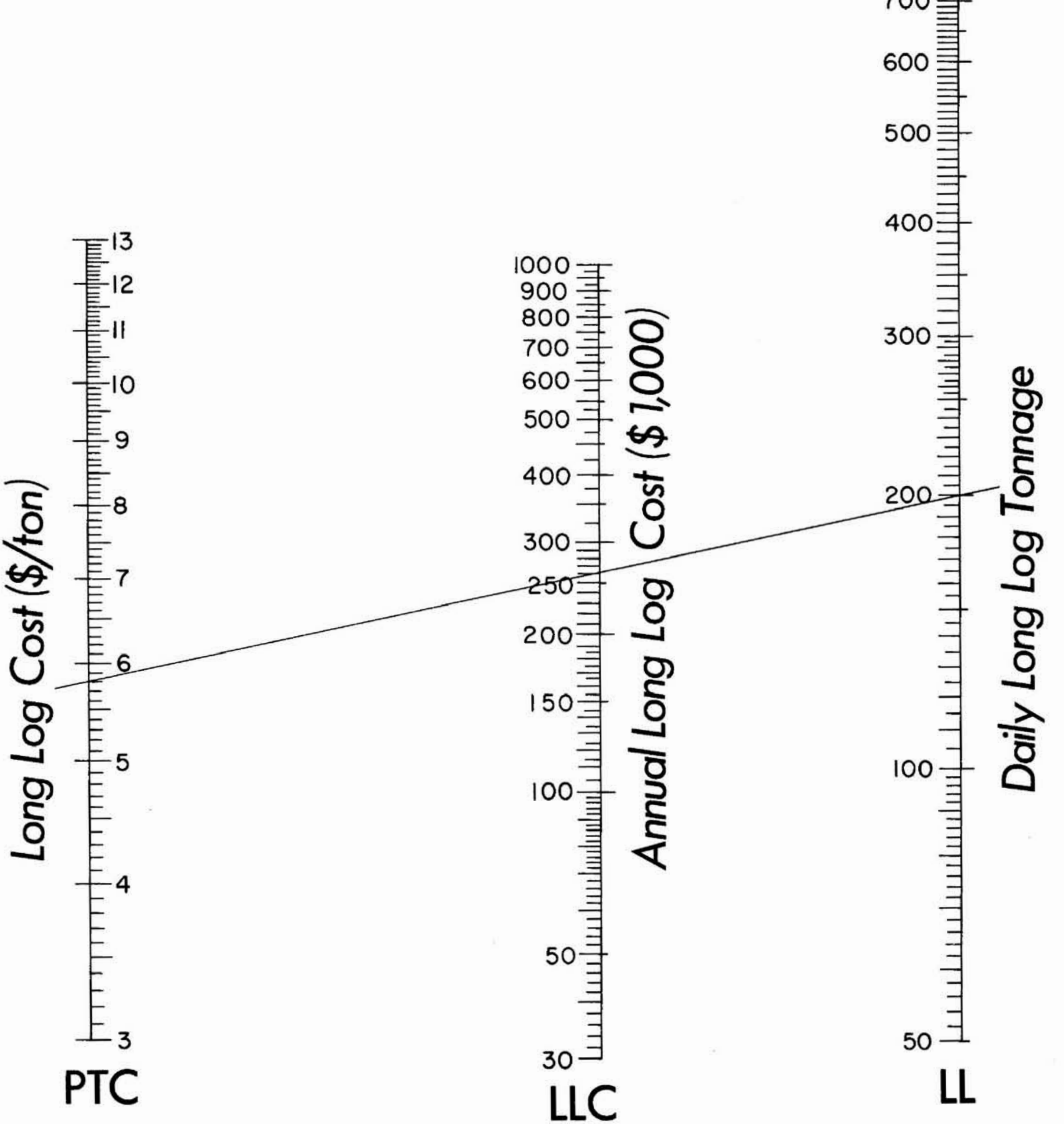
   b. Dollars per hundredweight: If the log costs are in dollars per hundredweight, the cost in dollars per ton may be read directly by comparing values on the PHC and PTC scales. Enter the long-log cost per ton as item 13 on the worksheet.
3. Proceed to step 8.

Example:

Weight scaling factor is:	5,850 lbs./cord
Estimated long-log price per cord is:	$17
Long-log cost per ton is read as:	$5.80

CHART 8

Annual Long Log Cost
for 225 Production Days Per Year
LLC = LL x PTC x 225/1000



STEP 8.
ANNUAL LONG-LOG COST

Assumption: 225 production-days per year.

Procedure:

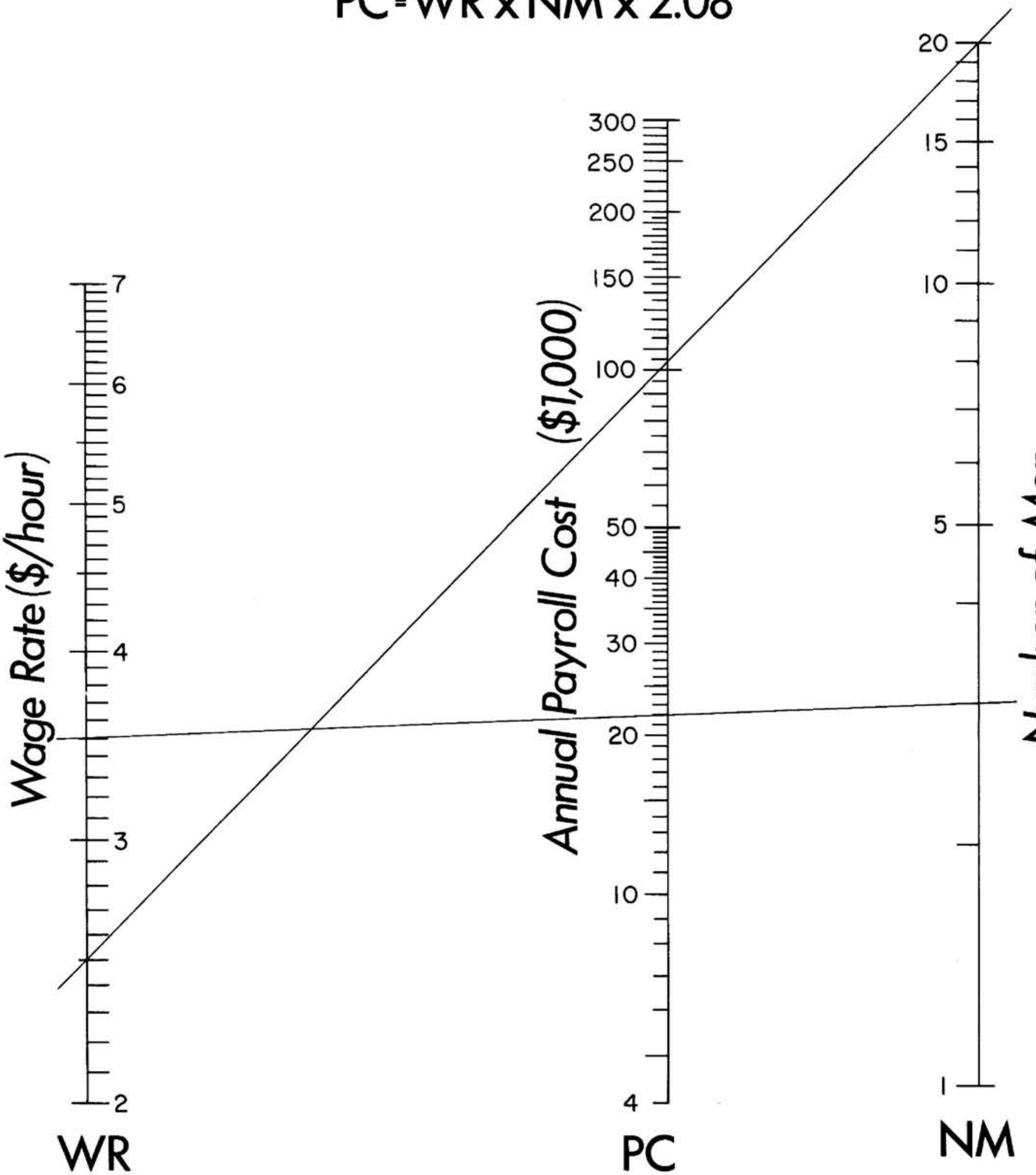
1. Using chart 8, mark the long-log cost per ton (item 13) on the PTC scale. Mark the daily long-log tonnage (item 6) on the LL scale. With a straightedge connect the two marks. Read the annual long-log cost on the LLC scale and enter the value as item 26 on the worksheet.
2. Proceed to step 9.

Example:

Long-log cost per ton is:	$5.80
Daily long-log tonnage is:	200 tons/day
Annual long-log cost is read as:	$263,000

CHART 9

Annual Payroll Costs
for 40 Hour Work Week and 52 Week Work Year
PC = WR x NM x 2.08



STEP 9.
ANNUAL PAYROLL COSTS

Assumption: Each employee will work 40 hours per week and will be paid for 52 weeks per year, including vacation and sick-leave time.

Procedure:

1. Determine the number of men to be employed and their average wage rates. Enter these values as item 14 on the worksheet.
2. Using chart 9, enter the number of men employed at a given annual wage rate on the NM scale. If more than 20 men are employed at a given average wage rate, the total can be divided into two smaller numbers. Enter the wage rate on the WR scale. With a straightedge read the annual payroll cost on the PC scale. Repeat for each different grouping of men and wage rates. Enter the total annual payroll costs as item 27 on the worksheet.
3. Proceed to step 10.

Example:

20 men at an hourly wage rate of $2.50:	$103,000
3 men at an hourly wage rate of $3.50:	$ 22,000
Total annual payroll cost ($103,000 + $22,000)	$125,000

This page intentionally left blank

STEP 10.
LISTING FINANCIAL VARIABLES

Procedure:

1. List the financial variable in part II of the worksheet.
2. Proceed to step 11.

Example:

Item No.		
15	Capital investment (total):	$550,000
16	Equity capital:	300,000
17	Borrowed capital:	250,000
18	Interest rate on borrowed capital:	8%
19	Interest rate on sinking fund:	6%
20	Percentage of income reserved for operations:	20%
21	Depreciation schedule:	Straight line

This page intentionally left blank

STEP 11.
DETERMINING TOTAL ANNUAL INCOME

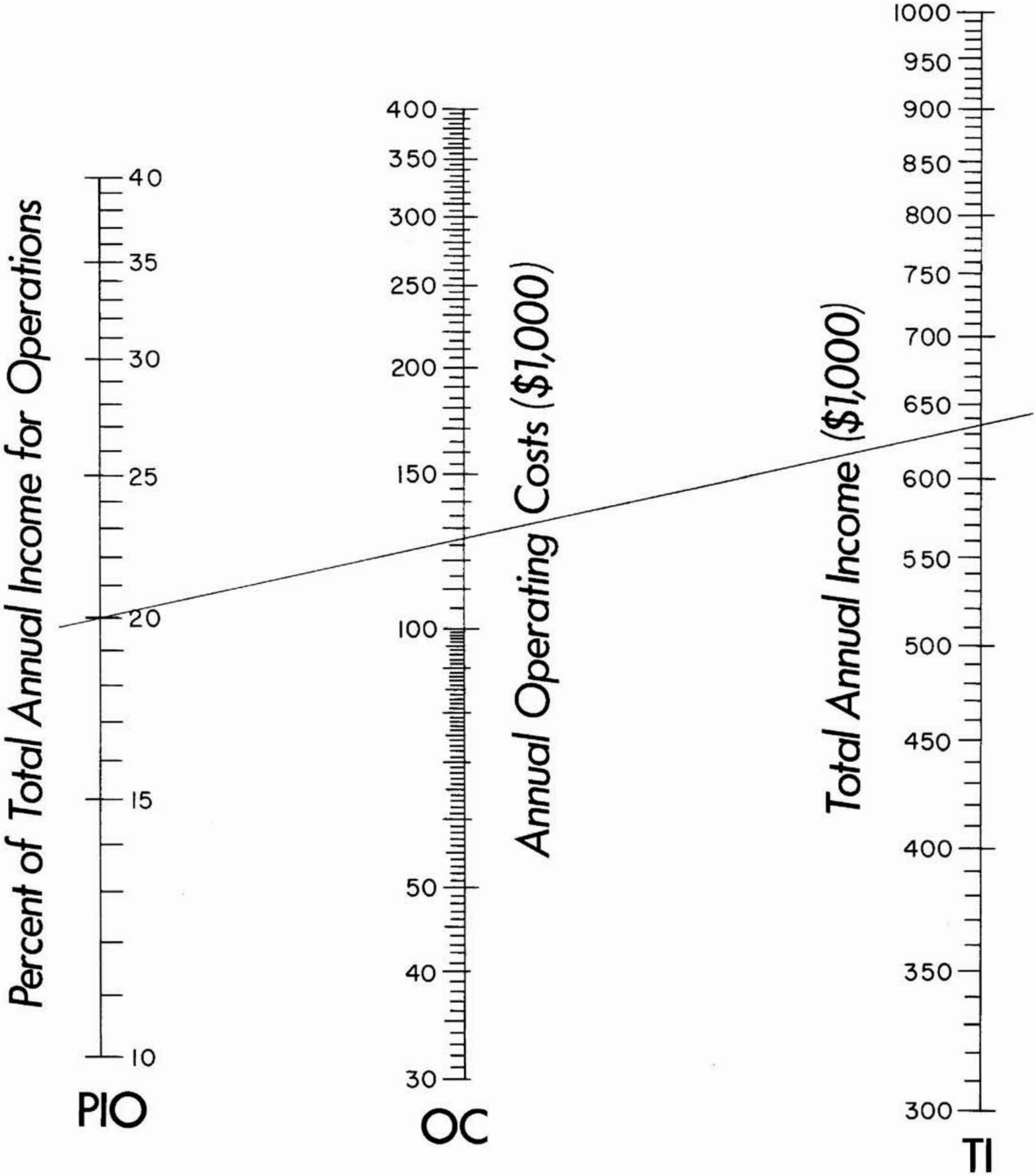
Procedure:

1. Add the sources of income (items 22, 23, and 24) and enter the total as item 25. It may be possible to convert some of the SHOLO mill residue into income-producing products. For example, 12 percent by weight of red oak logs is bark. With a daily input of 200 tons of long logs, 24 tons of bark per day are available for conversion into mulch. If any of the bark or other waste can be sold, the additional income is entered as item 24.
2. Proceed to step 12.

Example:

Sale of pallet parts:	$460,000
Sale of pulp chips:	$175,000
Additional sales:	0
Total annual income:	$635,000

CHART 10
Annual Operating Costs
OC=TI x PIO/100



STEP 12.
ANNUAL OPERATING COSTS

Assumption: None.

Procedure:

1. Using chart 10, enter the percentage of total income for operating costs (item 20) on the PIO scale. Then enter the total income (item 25) on the TI scale. With a straightedge connect these two marks. Read the operating costs on the OC scale and enter this value as item 28 on the worksheet.
2. Proceed to step 13.

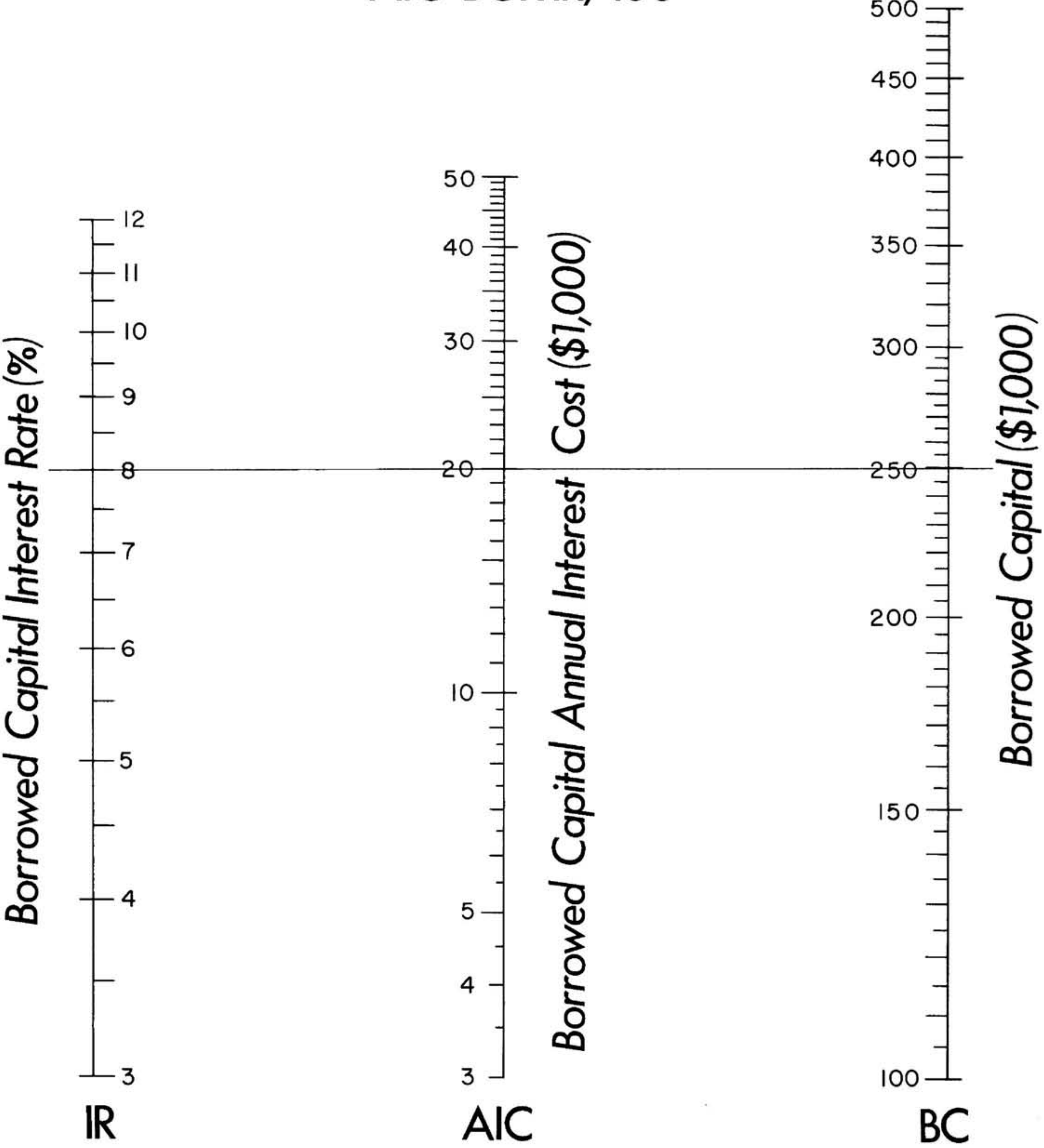
Example:

Percentage of total annual income reserved for operation:	20%
Total annual income:	$635,000
Annual operating costs is read as:	127,000

CHART 11

Borrowed Capital Annual Interest Cost

$AIC = BC \times IR/100$



STEP 13.
ANNUAL INTEREST COST

Assumption: None.

Procedure:

1. The interest cost is the charge for borrowed capital. In this example, we have assumed an interest rate of 8 percent (item 18) on both the bond that was used to raise $250,000 and the land, which was valued at $20,000. Interest on the land is computed at $1,600 per year; and this is entered as item 29. For interest on amounts over $100,000, chart 11 is used. Enter the interest rate (item 18) on the IR scale and the borrowed capital amount (item 17) on the BC scale. With a staightedge connect these two marks. Read the interest cost from the AIC scale and enter this value as item 30.
2. Proceed to step 14.

Example:

Land interest (0.08 x 20,000):	$ 1,600
Borrowed capital amount for bond:	250,000
Interest rate:	8%
Bond interest cost is read as:	20,000

This page intentionally left blank

STEP 14.
DETERMINATION OF TAXABLE INCOME

Procedure:

Taxable income is the total income (item 25) less expenses for logs (item 26), payroll (item 27), operations (item 28), land and bond interest charges (items 29 and 30), and annual depreciation. In our example, we used a straight-line depreciation schedule (item 20) and a 10-year plant life. Annual depreciation is, therefore, 10 percent of the total capital investment of $550,000 (item 15) or $55,000.

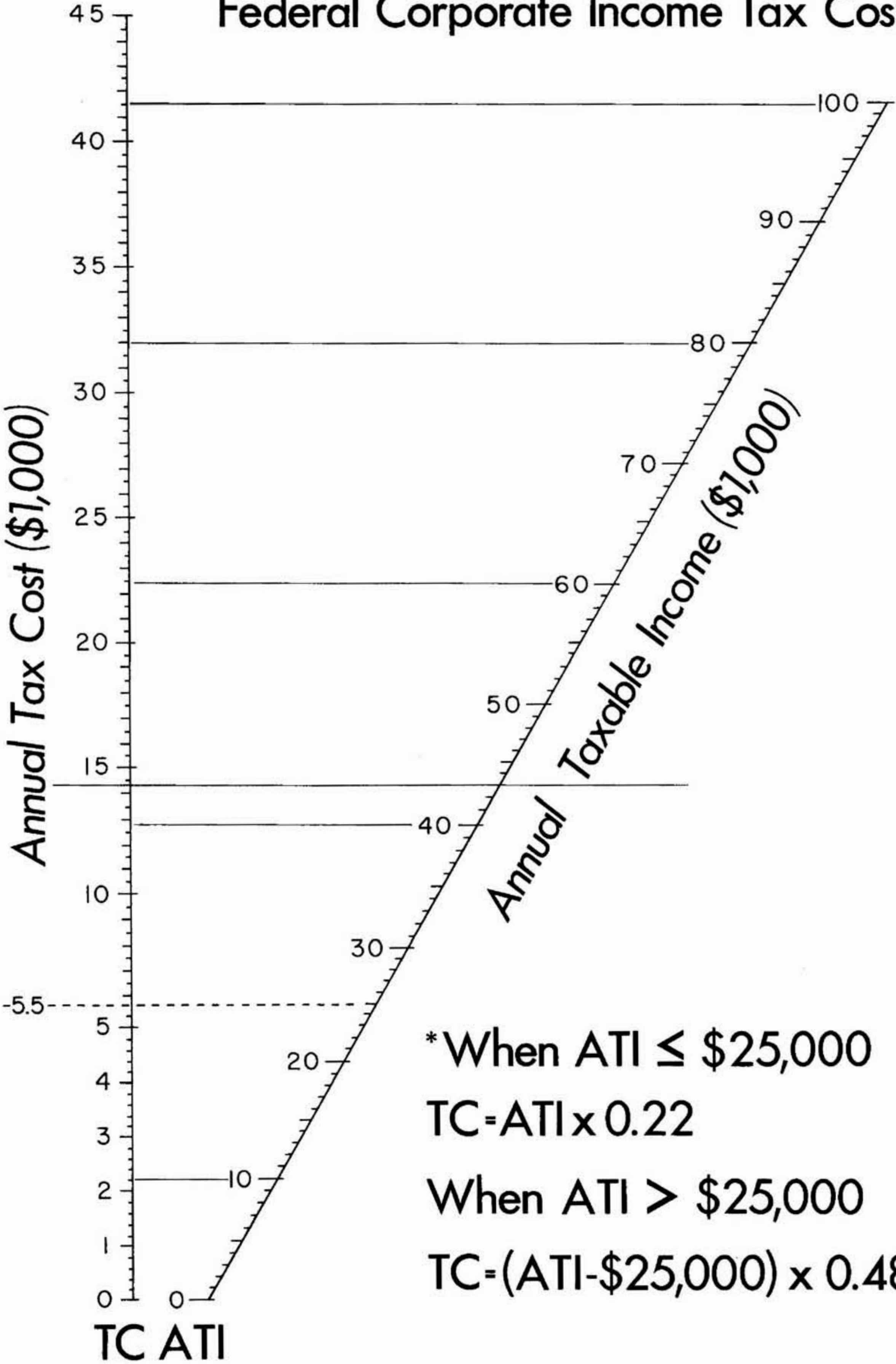
1. Add expense items 26, 27, 28, 29, 30, and enter the subtotal as item 31.
2. Enter the annual depreciation as item 32 on the worksheet.
3. Add items 31 and 32 and enter the total costs for tax purposes as item 33.
4. Subtract total costs for tax purposes (item 33) from the total income (item 25) and enter this as taxable income (item 34).
5. Proceed to step 15.

Example:

Taxable income (total annual income — total costs for tax purposes = $635,000 — $592,000):	$43,000

CHART 12

Federal Corporate Income Tax Cost*



*When ATI ≤ $25,000

TC = ATI x 0.22

When ATI > $25,000

TC = (ATI - $25,000) x 0.48 + $5,500

STEP 15.
ANNUAL FEDERAL TAX COSTS

Assumption: Tax rate is 22 percent on taxable income up to and including $25,000. Tax rate is 48 percent for taxable income over $25,000. State and local taxes are not included.

Procedure:

1. For annual taxable incomes of $100,000 or less:

   a. Using chart 12, enter the taxable income (item 34) on the ATI scale. With a straightedge draw a horizontal line from that point to the TC scale. Read the tax cost from the TC scale and enter this value as item 35 on the worksheet.

2. For annual taxable incomes above $100,000:

   a. Compute the annual tax cost, using the formula:
   $TC = (ATI - \$25{,}000) \times 0.48 + \$5{,}500$
   where

TC = annual tax cost in dollars.

ATI = annual taxable income in dollars.

CAUTION: Do not try to use chart 12 by dividing the annual taxable income into two or more subtotals. The annual tax costs that result will not add up to the actual tax costs. As an example, two times the tax cost for an income of $50,000 does not equal the tax cost for an income of $100,000.

3. Proceed to step 16.

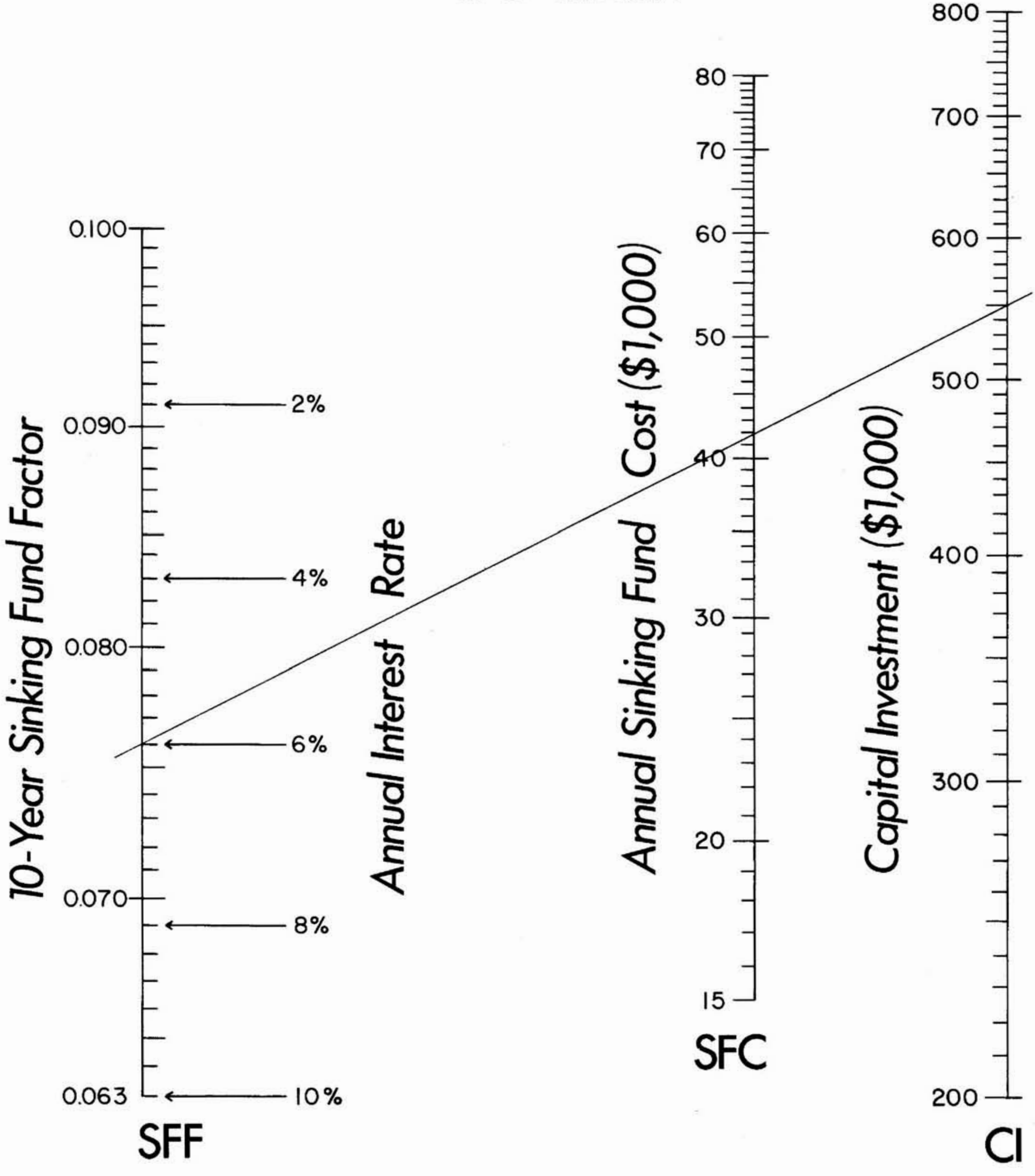
Example:

Taxable income:	$43,000
Tax cost is read as:	14,300

CHART 13

Annual Sinking Fund Cost

SFC = CI x SFF



STEP 16.
SINKING FUND COSTS

Assumption: Ten-year plant life, with no salvage value at the end of that time.

Procedure:

The sinking fund accumulates money to pay off the borrowed capital and the owner's equity investment at the end of the life of the plant. The sinking fund, which is a form of savings, earns interest, which is used to reduce the annual principal payment into the fund.

1. Using chart 13, enter the sinking-fund factor corresponding to the sinking-fund annual interest rate on the SFF scale. Enter the total capital investment (item 15) on the CI scale. Read the sinking-fund cost from the SFC scale and enter this value as item 36 on the worksheet.
2. Proceed to step 17.

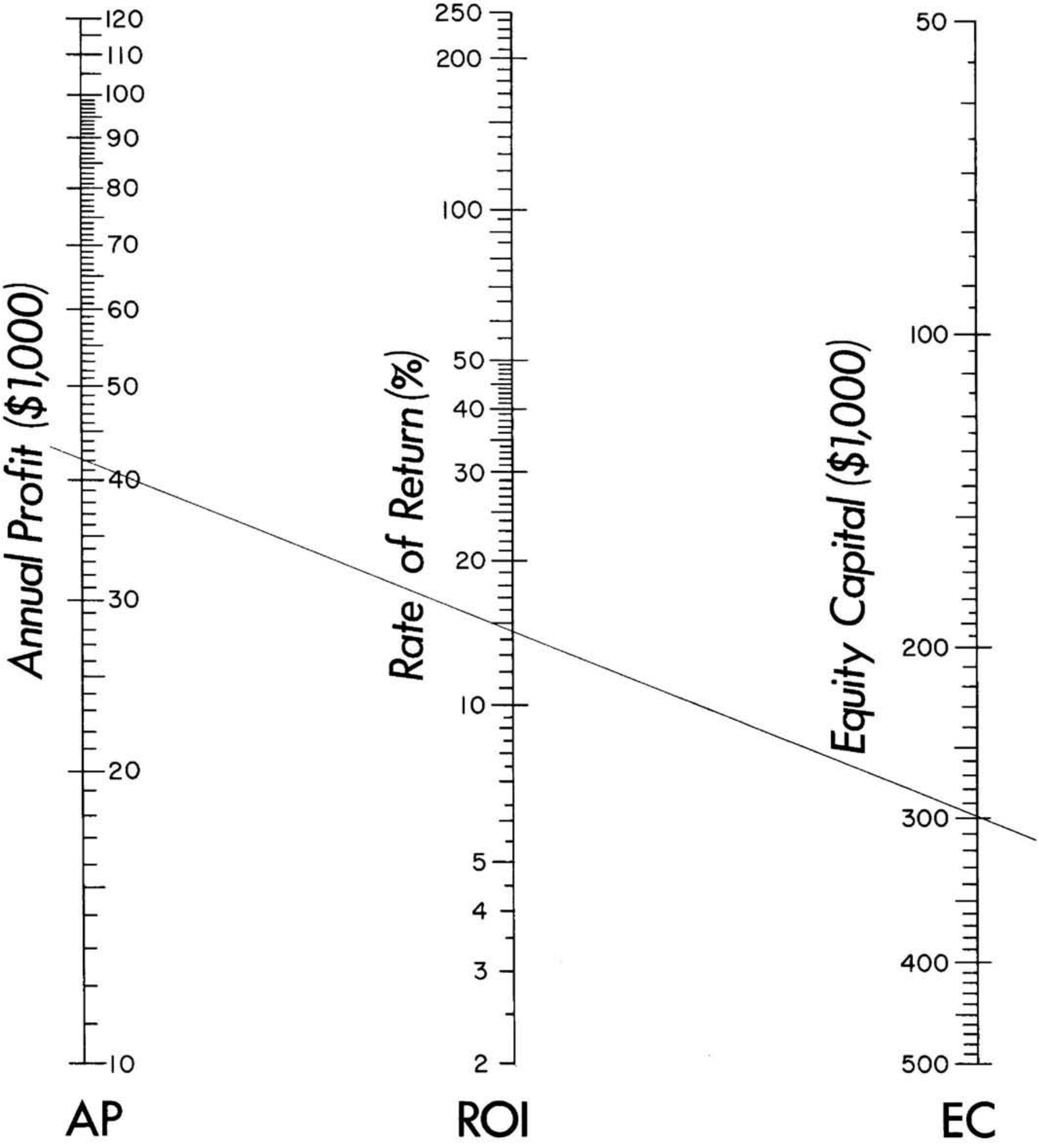
Example:

Sinking-fund annual interest rate is:	6%
Therefore the 10-year sinking-fund factor is:	0.076
The total capital investment is:	$550,000
The sinking-fund cost is read as:	42,000

CHART 14

Rate of Return on Equity Capital

$$ROI = \frac{AP}{EC} \times 100$$



STEP 17.
DETERMINING THE RATE OF RETURN ON INVESTMENT

Assumption: None.

Procedure:

The return on investment (in percent) is the ratio of the annual profit to the equity capital investment times 100.

1. Determine the total expenses by adding item 31 (expense subtotal), item 35 (tax costs), and item 36 (sinking fund costs). Enter this sum as the expense total (item 37).
2. Determine the annual profit by subtracting item 37 (expense total) from item 25 (total annual income). Enter the annual profit as item 38.
3. Using chart 14, enter the annual profit (item 38) on the AP scale. Enter the equity capital (item 16) on the EC scale. Read the rate of return on investment from the ROI scale.

Example:

Total expenses:	$593,000
Annual profit (annual income — total expenses = $635,000 — $593,000):	42,000
Equity capital:	300,000
Rate of return on equity capital is read as:	14.5%

INFLUENCE OF FACTOR VALUES ON THE RETURN ON INVESTMENT

We have illustrated our method for determining the return on investment for *one* SHOLO mill design and for *one* set of production and financial factors. This method is flexible and can be used for *any* SHOLO mill design and for *any* combination of production and financial factors. Further, the careful user will soon gain an appreciation of the factors most important to him. For any given set of conditions, some factors are more important than others.

Consider some value changes in the factors. Except as otherwise noted, the values of the production and financial factors will remain the same.

EXAMPLE 1.—REDUCE EQUITY CAPITAL TO $275,000 (A $25,000 DECREASE).

Reducing the equity capital to $275,000 will result in a return on investment of about 15.1 percent (up 0.6 percent). At first glance, a larger increase would be expected as we divide the annual profit by the equity capital to arrive at the return on investment. However, there are other effects that must be considered.

Reducing the equity means that more money must be borrowed. In this example, borrowing $25,000 more increases the annual bond interest costs by $2,000, reduces the taxable income by $2,000, reduces the annual tax costs by $1,000, and also reduces the annual profit by $1,000.

Even though the return on investment is not increased greatly, the fact remains that a reduction in equity capital does give a slight improvement. This suggests that an investor should use the minimum equity allowable.

EXAMPLE 2.—INCREASE DAILY INPUT OF LONG LOGS TO 210 TONS (A 10 TON INCREASE).

Increasing the amount of long logs processed per day to 210 tons increases the total annual income by $27,000. (To work this example, start with chart 3. Work backwards to chart 1. Proceed with chart 4 as before.) But the return on investment is increased to only 15 percent (up 0.5 percent). This small increase is the result of the following changes:

Factor	*Amount of increase*
Pallet parts	0.7MBF/day
Pulp chips	5 tons/day
Income from sale of pallet parts	$20,000/year
Income from sale of pulp chips	$ 7,000/year
Long-log costs	$17,000
Operating costs	$ 6,000
Tax costs	$ 2,000
Annual profit	$ 2,000

Though income is increased by $27,000, costs are increased by $25,000. So the increase in profits is only $2,000 per year.

If we conclude that there is no need to increase the operating costs, then we still do not change the result appreciably. By not increasing these costs by $6,000, we increase the tax costs by $3,000. The net effect is to increase the annual profit by $5,000 rather than the $2,000 mentioned above. The result is that the return on investment is increased to 16.3 percent (up less than 2 percent).

EXAMPLE 3.—INCREASE THE SELLING PRICE OF FINISHED PALLET PARTS TO $135/MBF (AN INCREASE OF $7/MBF).

Increasing the selling price of pallet parts to $135/MBF increases the total annual income by about $27,000. However, the annual profit is increased by only $10,000. This is because the operating costs are increased by $7,000 and the tax costs are increased by $10,000. The net effect is to increase the return on investment to 18 percent (up 3.5 percent).

If we decide not to increase the operating costs by $7,000, then the return on investment will be increased to 18.7 percent (up 4.2 percent). Again, the increase in tax costs (up $13,000) minimizes an increase in profits (up $14,000). A decision must be made whether a 0.7-percent increase in return on investment is worth a $7,000 margin in operating costs.

EXAMPLE 4.—DECREASE THE PROCESSING CREW TO 18 MEN AT $2.50 PER HOUR AND 3 MEN AT $3.50 PER HOUR (A DECREASE OF 2 MEN AT $2.50 PER HOUR).

Operating the mill with two less men at a wage rate of $2.50 increases the return on investment to 16.5 percent (up 2 percent). There is a reduction in annual payroll costs of $11,000 and an increase in tax costs of $5,000. The net effect is an increase in profits of $6,000.

Care must be taken to consider all the desired changes at one time. Adding the increases in the return on investment from each of the four examples (0.6 + 0.5 + 3.5 + 2.0) results in a total increase of 6.6 percent. But, if we make all of the changes at one time, we get a return on investment of 22.5 percent or an increase of 8 percent.

The difference is the result of the arithmetic involved. For example: changing the price and the amount of pallet parts gives slightly more income than adding the increases from (1) increasing the price of the original amount of pallet parts and (2) increasing the amount of pallet parts at the original price. But for the four examples given, there is a more important factor. When done individually, the returns on investment for three of the examples are based on an equity capital of $300,000. Only one example is based on an equity of $275,000. But when all the examples are combined, the effect of all the factors is based on the $275,000 equity.

Individual examples are of value in pointing out important factors. They prevent us from considering only changes in income and require us to consider the affect of changes on profits. From the examples given above, we can see that a reduction in equity capital or the ability to process 10 tons of long logs more per day will not greatly change the return on investment. On the other hand, increases in the selling price or reductions in labor costs have greater effects.

MODIFYING THE SHOLO MILL DESIGN

The modifications given above are on our SHOLO mill design and on our choice of factors. Though we believe these to be realistic, it is unlikely that most readers will have the same set of conditions. We would like to illustrate the flexibility of the SHOLO-mill concept with an example in which the design of the SHOLO mill is changed.

Assume that 250 tons of long-logs—rather than 200 tons—are available per day. Two questions arise immediately.

First, can we process an additional 50 tons per day with the present design? The answer is no. The capacity of the headrig and the two pairs of tandem straight-line ripsaws are not adequate to handle this amount.

Second, should we convert the extra 50 tons directly to pulp chips? This question requires a deeper analysis. Though there is an adequate chipping capacity, a faster debarker is needed to process the additional 50 tons of long logs during a single shift. An additional $20,000 capital investment will be needed for the improved debarker. An increase of $3,000 per year in operating expenses is required for additional electrical power and maintenance. However, the net income from pulp chips is only about $1,000 per year. Though there is an additional annual income from the sale of pulp chips of $68,000, there is also an additional increase in the annual long-log cost of $67,000. Thus we see that this approach to the conversion of the 50 extra tons of long logs will lose money so we reject it.

There is a third possibility. Having an additional 50 tons of long logs allows the slasher-saw operator to be more selective in bucking the long logs into SHOLO logs. Assume that by selecting the best 80 percent of the long logs it is reasonable to expect that the long-log potential will increase from 57 to 65 percent. We now have 200 tons of long logs with a long-log potential of 65 percent and 50 tons of long logs for direct conversion into pulp chips. The slasher-saw operator can easily buck the pulp-chip logs into easily handled lengths. Work through this problem step by step and refer to worksheet 2. The following factors are known at the beginning:

Item No.	*Depreciation*	*Amount*
2	Pallet-part selling price	$128/MBF
3	SHOLO-log potential	28%
5	Long-log potential for 200 tons	65%
	Long-log potential for 50 tons	0%
6	Long-log tonnage	250 tons
11	Pulp-chip selling price	$7/ton
12	Weight scaling factor	5,850 lbs/cord
13	Long-log cost per ton	$5.80
16	Equity capital	$300,000
18	Interest rate on borrowed capital and land	8%
19	Interest rate on sinking fund	6%
21	Depreciation schedule	Straight line

To determine the return on investment, we proceed with the following steps:

Step 1.—Determine the SHOLO-log tonnage from 200 tons of long logs at a long-log potential of 65 percent. Using chart 3, we find the SHOLO-log tonnage is 130 tons per day.

Step 2.—Determine the daily pallet part production rate. Using chart 2, we find the pallet-part production rate is 18.2 MBF per day. This amount of parts exceeds the capacity of the two pairs of tandem-operated straight-line ripsaws. We note that an additional pair will be needed, at a cost of $20,000. Also, an additional man, at $2.50 per hour, will be needed to operate the saws.

Step 3.—Determine the annual income from the sale of pallet parts. Using chart 1, we determine the annual income from the sale of pallet parts to be $525,000 per year.

Step 4.—Determine the round-residue quantity. The round-residue quantity is normally determined by subtracting the

SHOLO-log tonnage from the long-log tonnage. In this case, be careful to subtract the SHOLO-log tonnage from the 200 tons of long logs from which they were bucked. Then add the 50 tons of long logs that were not converted to SHOLO logs. In this example we have 120 tons of round residue.

Step 5.—Determine the total daily pulp-chip production. Using charts 4 and 5, we find that the daily pulp-chip production from round residue and from SHOLO-log residue to be 103 and 42 tons respectively. The total pulp-chip production is 145 tons per day.

Step 6.—Determine the annual income from the sale of pulp chips. Using chart 6, we find that the annual income from the sale of the pulp chips is $230,000.

Step 7.—Determine total annual income. Add items 22 and 23 in worksheet 2 to get a total annual income of $755,000.

Step 8.—Determine long-log costs. Using chart 8, we find that the annual long-log cost is $330,000.

Step 9.—Determine labor costs. In step 2, we found that an additional man at $2.50 per hour will be needed. Using chart 9, we find that the total annual payroll costs for 21 men at $2.50 per hour and 3 men at $3.50 per hour is $130,000.

Step 10.—Determine financial variables. We estimate that the capital investment will be increased by $50,000 to $600,000 and that this additional $50,000 will be borrowed. The $50,000 will be used to improve the debarking capacity and for an additional pair of straight-line ripsaws. This sum is adequate to cover any capital improvements required by these two items.

An additional $8,000 in operating money is needed to cover the additional costs of the extra man and the additional electrical power and maintenance. Because the total annual income has been increased, we can supply the additional money with a factor of 18 percent of this income reserved for operations.

Step 11.—Determine annual interest charges. The land interest costs remain the same at $1,600. But the borrowed capital has been increased by $50,000 to $300,000. Using chart 11, we find the borrowed capital interest to be $24,000 per year.

Step 12.—Determine annual depreciation. The total capital investment has been increased by $50,000 to $600,000. Using a 10-year plant life and straight-line depreciation, we find that the annual depreciation is $60,000 per year.

Step 13.—Determine tax costs. The total annual income is $755,000. The total cost for tax purposes is $681,000. Therefore the taxable income is $74,000. Using chart 12, we find the tax costs to be $29,100.

Step 14.—Determine annual sinking-fund costs. Using chart 6, we find that the sinking-fund cost for $600,000 at an annual interest rate of 6 percent is $45,200 per year.

Step 15.—Determine the return on investment. The total annual expenses for the SHOLO mill are found to be $695,000. When this amount is subtracted from the total annual income of $755,000, the result is an annual profit of $60,000. Using chart 14, we find that the return on investment is 20 percent.

Conclusion:—Modifying the SHOLO mill design in the manner described is worthwhile.

SUMMARY

One way to decide whether to invest in a SHOLO mill is to determine the return on invested capital and compare this with other alternatives. This report is a working tool in which is given a detailed procedure for determining the return on investment. Basing examples on actual pilot-plant tests of samples of raw material, we have illustrated the influence of individual factors. The flexibility of the procedure is shown by making several changes in the design of the SHOLO mill. Without attempting to show the best set of conditions, we have illustrated how different returns on investment, from 14 to 22.5 percent, are obtainable when converting low-grade hardwood logs to pallet parts and pulp chips.

Worksheet 1.--Return on investment for illustrated SHOLO mill design

Item	Description		Amount
	PRODUCTION VARIABLES		
1	Pallet part production rate	(MBF/Day)	16
2	Pallet part selling price	($/MBF)	128
3	SHOLO log potential	(%)	28
4	SHOLO log tonnage	(Tons/Day)	114
5	Long log potential	(%)	57
6	Long log tonnage	(Tons/Day)	200
7	Round residue quantity (Item 6 less 4)	(Tons/Day)	86
8	Pulp chips from round residue	(Tons/Day)	74
9	Pulp chips from SHOLO logs	(Tons/Day)	37
10	Total daily pulp chip production (Item 8 plus 9)	(Tons/Day)	111
11	Pulp chip selling price	($/Ton)	7
12	Weight scaling factor	(Lbs/Cord)	5,850
13	Long log cost per ton	($/Ton)	5.80
	LABOR VARIABLES		
14	No. of employees and wage rate	($/Hour)	20 @ 2.50
		($/Hour)	3 @ 3.50
		($/Hour)	
	FINANCIAL VARIABLES		
15	Capital investment (total)		550,000
16	Equity capital		300,000
17	Borrowed capital		250,000
18	Interest rate on borrowed capital and land	(%)	8
19	Interest rate on sinking fund	(%)	6
20	Percentage of total income reserved for operations	(%)	20
21	Depreciation schedule		Straight line

Item	Description	Amount (thousands)
	ANNUAL INCOME	
22	Sale of pallet parts	460
23	Sale of pulp chips	175
24	Additional sales	0
25	Total annual income	635
	ANNUAL EXPENSES	
26	Long log costs	263
27	Payroll costs	125
28	Operating costs	127
29	Land interest costs	1.6
30	Bond interest costs	20
31	Expense subtotal	536.6
32	Annual depreciation	55
33	Total cost for tax purposes (Items 31+32)	592
34	Taxable income (Item 25 less 33)	43
35	Tax costs	14.3
36	Sinking fund costs	42
37	Expense total (Sum of 31+35+36)	593
	ANNUAL PROFIT	
38	Profit (Item 25 less 37)	42
39	Return on investment = $\frac{\text{Annual profit}}{\text{Equity capital}} \times 100$	14.5

SHOLO ROI TRIAL NO. ______
Location/description ______
Prepared by: ______
Title: ______ Date ______
Reviewed by: ______
Title: ______ Date ______

USDA Forest Service
Northeastern Forest Experiment Station
Forest Products Marketing Laboratory
Princeton, West Virginia

by Hugh W. Reynolds and Charles J. Gatchell

Worksheet 2.--Return on investment for modified SHOLO mill design

Item	Description		Amount
	PRODUCTION VARIABLES		
1	Pallet part production rate	(MBF/Day)	18.2
2	Pallet part selling price	($/MBF)	128
3	SHOLO log potential	(%)	28
4	SHOLO log tonnage	(Tons/Day)	130
5	Long log potential	(%)	65
6	Long log tonnage	(Tons/Day)	200+50
7	Round residue quantity (Item 6 less 4)	(Tons/Day)	70 +50
8	Pulp chips from round residue	(Tons/Day)	103
9	Pulp chips from SHOLO logs	(Tons/Day)	42
10	Total daily pulp chip production (Item 8 plus 9)	(Tons/Day)	145
11	Pulp chip selling price	($/Ton)	7
12	Weight scaling factor	(Lbs/Cord)	5,850
13	Long log cost per ton	($/Ton)	5.80
	LABOR VARIABLES		
14	No. of employees and wage rate	($/Hour)	21 @ 2.50
		($/Hour)	3 @ 3.50
		($/Hour)	
	FINANCIAL VARIABLES		
15	Capital investment (total)		600,000
16	Equity capital		300,000
17	Borrowed capital		300000
18	Interest rate on borrowed capital and land	(%)	8
19	Interest rate on sinking fund	(%)	6
20	Percentage of total income reserved for operations	(%)	18
21	Depreciation schedule		Straight line

Item	Description	Amount (thousands)
	ANNUAL INCOME	
22	Sale of pallet parts	525
23	Sale of pulp chips	230
24	Additional sales	
25	Total annual income	755
	ANNUAL EXPENSES	
26	Long log costs	330
27	Payroll costs	130
28	Operating costs	135
29	Land interest costs	1.6
30	Bond interest costs	24
31	Expense subtotal	620.6
32	Annual depreciation	60
33	Total cost for tax purposes (Items 31+32)	681
34	Taxable income (Item 25 less 33)	74
35	Tax costs	29.1
36	Sinking fund costs	45.2
37	Expense total (Sum of 31+35+36)	695
	ANNUAL PROFIT	
38	Profit (Item 25 less 37)	60
39	Return on investment = $\frac{\text{Annual profit}}{\text{Equity capital}}$ x 100	20

SHOLO ROI TRIAL NO. ______

Location/description ____________________

Prepared by: ____________________

Title: ____________________ Date ________

Reviewed by: ____________________

Title: ____________________ Date ________

USDA Forest Service
Northeastern Forest Experiment Station
Forest Products Marketing Laboratory
Princeton, West Virginia

by Hugh W. Reynolds and Charles J. Gatchell

Worksheet

Item	Description		Amount
	PRODUCTION VARIABLES		
1	Pallet part production rate	(MBF/Day)	
2	Pallet part selling price	($/MBF)	
3	SHOLO log potential	(%)	
4	SHOLO log tonnage	(Tons/Day)	
5	Long log potential	(%)	
6	Long log tonnage	(Tons/Day)	
7	Round residue quantity (Item 6 less 4)	(Tons/Day)	
8	Pulp chips from round residue	(Tons/Day)	
9	Pulp chips from SHOLO logs	(Tons/Day)	
10	Total daily pulp chip production (Item 8 plus 9)	(Tons/Day)	
11	Pulp chip selling price	($/Ton)	
12	Weight scaling factor	(Lbs/Cord)	
13	Long log cost per ton	($/Ton)	
	LABOR VARIABLES		
14	No. of employees and wage rate	($/Hour)	
		($/Hour)	
		($/Hour)	
	FINANCIAL VARIABLES		
15	Capital investment (total)		
16	Equity capital		
17	Borrowed capital		
18	Interest rate on borrowed capital and land	(%)	
19	Interest rate on sinking fund	(%)	
20	Percentage of total income reserved for operations	(%)	
21	Depreciation schedule		

Item	Description	Amount (thousands)
	ANNUAL INCOME	
22	Sale of pallet parts	
23	Sale of pulp chips	
24	Additional sales	
25	Total annual income	
	ANNUAL EXPENSES	
26	Long log costs	
27	Payroll costs	
28	Operating costs	
29	Land interest costs	
30	Bond interest costs	
31	Expense subtotal	
32	Annual depreciation	
33	Total cost for tax purposes (Items 31+32)	
34	Taxable income (Item 25 less 33)	
35	Tax costs	
36	Sinking fund costs	
37	Expense total (Sum of 31+35+36)	
	ANNUAL PROFIT	
38	Profit (Item 25 less 37)	
39	Return on investment = $\frac{\text{Annual profit}}{\text{Equity capital}} \times 100$	

SHOLO ROI TRIAL NO. ______

Location/description ____________________

Prepared by: ____________________

Title: ____________________ Date ________

Reviewed by: ____________________

Title: ____________________ Date ________

USDA Forest Service
Northeastern Forest Experiment Station
Forest Products Marketing Laboratory
Princeton, West Virginia

by Hugh W. Reynolds and Charles J. Gatchell

Worksheet

Item	Description		Amount
	PRODUCTION VARIABLES		
1	Pallet part production rate	(MBF/Day)	
2	Pallet part selling price	($/MBF)	
3	SHOLO log potential	(%)	
4	SHOLO log tonnage	(Tons/Day)	
5	Long log potential	(%)	
6	Long log tonnage	(Tons/Day)	
7	Round residue quantity (Item 6 less 4)	(Tons/Day)	
8	Pulp chips from round residue	(Tons/Day)	
9	Pulp chips from SHOLO logs	(Tons/Day)	
10	Total daily pulp chip production (Item 8 plus 9)	(Tons/Day)	
11	Pulp chip selling price	($/Ton)	
12	Weight scaling factor	(Lbs/Cord)	
13	Long log cost per ton	($/Ton)	
	LABOR VARIABLES		
14	No. of employees and wage rate	($/Hour)	
		($/Hour)	
		($/Hour)	
	FINANCIAL VARIABLES		
15	Capital investment (total)		
16	Equity capital		
17	Borrowed capital		
18	Interest rate on borrowed capital and land	(%)	
19	Interest rate on sinking fund	(%)	
20	Percentage of total income reserved for operations	(%)	
21	Depreciation schedule		

Item	Description	Amount (thousands)
	ANNUAL INCOME	
22	Sale of pallet parts	
23	Sale of pulp chips	
24	Additional sales	
25	Total annual income	
	ANNUAL EXPENSES	
26	Long log costs	
27	Payroll costs	
28	Operating costs	
29	Land interest costs	
30	Bond interest costs	
31	Expense subtotal	
32	Annual depreciation	
33	Total cost for tax purposes (Items 31+32)	
34	Taxable income (Item 25 less 33)	
35	Tax costs	
36	Sinking fund costs	
37	Expense total (Sum of 31+35+36)	
	ANNUAL PROFIT	
38	Profit (Item 25 less 37)	
39	Return on investment = $\frac{\text{Annual profit}}{\text{Equity capital}} \times 100$	

USDA Forest Service
Northeastern Forest Experiment Station
Forest Products Marketing Laboratory
Princeton, West Virginia

by Hugh W. Reynolds and Charles J. Gatchell

SHOLO ROI TRIAL NO. ______

Location/description ______________________

____

____

Prepared by: ______________________

Title: ______________ Date ______

Reviewed by: ______________________

Title: ______________ Date ______

Worksheet

Item	Description		Amount
	PRODUCTION VARIABLES		
1	Pallet part production rate	(MBF/Day)	
2	Pallet part selling price	($/MBF)	
3	SHOLO log potential	(%)	
4	SHOLO log tonnage	(Tons/Day)	
5	Long log potential	(%)	
6	Long log tonnage	(Tons/Day)	
7	Round residue quantity (Item 6 less 4)	(Tons/Day)	
8	Pulp chips from round residue	(Tons/Day)	
9	Pulp chips from SHOLO logs	(Tons/Day)	
10	Total daily pulp chip production (Item 8 plus 9)	(Tons/Day)	
11	Pulp chip selling price	($/Ton)	
12	Weight scaling factor	(Lbs/Cord)	
13	Long log cost per ton	($/Ton)	
	LABOR VARIABLES		
14	No. of employees and wage rate	($/Hour)	
		($/Hour)	
		($/Hour)	
	FINANCIAL VARIABLES		
15	Capital investment (total)		
16	Equity capital		
17	Borrowed capital		
18	Interest rate on borrowed capital and land	(%)	
19	Interest rate on sinking fund	(%)	
20	Percentage of total income reserved for operations	(%)	
21	Depreciation schedule		

Item	Description	Amount (thousands)
	ANNUAL INCOME	
22	Sale of pallet parts	
23	Sale of pulp chips	
24	Additional sales	
25	Total annual income	
	ANNUAL EXPENSES	
26	Long log costs	
27	Payroll costs	
28	Operating costs	
29	Land interest costs	
30	Bond interest costs	
31	Expense subtotal	
32	Annual depreciation	
33	Total cost for tax purposes (Items 31+32)	
34	Taxable income (Item 25 less 33)	
35	Tax costs	
36	Sinking fund costs	
37	Expense total (Sum of 31+35+36)	
	ANNUAL PROFIT	
38	Profit (Item 25 less 37)	
39	Return on investment = $\frac{\text{Annual profit}}{\text{Equity capital}} \times 100$	

SHOLO ROI TRIAL NO. ______

Location/description ______________________

Prepared by: ______________________

Title: ______________________ Date ________

Reviewed by: ______________________

Title: ______________________ Date ________

USDA Forest Service
Northeastern Forest Experiment Station
Forest Products Marketing Laboratory
Princeton, West Virginia

by Hugh W. Reynolds and Charles J. Gatchell