Optimal Integer Coordinate for Plant

The Spencer Shoe Company manufactures a line of inexpensive shoes in one plant in Pontiac and distributes to five main distribution centers (Milwaukee, Dayton, Cincinnati, Buffalo, and Atlanta) from which the shoes are shipped to retail shoe stores. Distribution costs include freight, handling, and warehousing costs. To meet increased demand, the company has decided to build at least one new plant with a capacity of 40,000 pairs per week. Surveys have narrowed the choice to three locations: Cincinnati, Dayton, and Atlanta. As expected, production costs would be low in the Atlanta plant, but distribution costs are relatively high compared to those of the other two locations. Other data are as follows:

Distribution Costs per Pair

To	From				Demand
Distribution Centers	Pontiac	Cincinnati	Dayton	Atlanta	(pairs/wk)
Milwaukee	$0.42	$0.46	$0.44	$0.48	10,000
Dayton	0.36	0.37	0.30	0.45	15,000
Cincinnati	0.41	0.30	0.37	0.43	16,000
Buffalo	0.39	0.42	0.38	0.46	19,000
Atlanta	0.50	0.43	0.45	0.27	12,000
Capacity (pairs/wk.)	27,000	40,000	40,000	40,000	
Production cost/pair	$2.70	$2.64	$2.69	$2.62	
Fixed cost/wk.	$7,000	$4,000	$6,000	$7,000	

a. Assume that the Pontiac plant has no resale value and must remain open. What are the plant locations that will minimize total costs, including production, distribution, and fixed costs?
What is the optimal total cost?
b. Assume that the Pontiac plant could be closed at zero net cost. What are the optimal locations? What is the optimal total cost?

Source of this problem: Question 10 of Chapter 11 “Integer Optimization” of book ``Business Analytics: The Art of Modeling with Spreadsheets", by Stephen G. Powell and Kenneth R. Baker, 5 th Edition, 2017, John Wiley and Sons.