

## 6.13 Exercises

1. A small water utility has rates consisting of a monthly charge of \$25 plus a constant charge of \$5 per metered 1,000 gallons. These charges are adequate to meet the utility's operation and maintenance costs, but they include no accounting for natural water value. Presently, the two hundred customers consume 2.0855 million gallons (6.4 af) in a normal month. According to a new court ruling, the utility has been overstepping its water rights, and it really only has the right to 4.8 acre-feet per month. Because the utility can lease additional, senior water rights at a price of \$160 per acre-foot, management has proposed a two-pronged policy: lease the full shortfall, and finance the added costs with either an increased meter charge for all consumers or an increased water rate. Analyze these circumstances, and make a recommendation.

2. Draw a graph containing three curves: marginal benefits, marginal costs, and average costs. Make sure marginal costs are correctly related to average costs in your graph. (Marginal costs should intersect average costs where average costs are at their lowest level.) Starting from a prepolicy scenario involving average-cost pricing, identify on your graph the areas representing consumer net benefits and supplier net benefits. Suppose that a change to marginal-cost pricing is proposed. In a postpolicy scenario involving marginal-cost pricing, identify on your graph the areas representing consumer net benefits and supplier net benefits. What is the change in net benefits for consumers and the supplier, separately? What is the aggregated change in net benefits? What does your theoretical analysis tell you about the preferred method of pricing retail water?

3. Suppose retail water demand is given by  $w_d = 70 - p$  and the marginal costs of retail water is  $mc = 0.00125w_s^2$ . (Invert the latter equation and substitute  $p$  for  $mc$  to obtain the supply function corresponding to marginal-cost pricing.) Currently, the supplier cannot fulfill the quantity demanded under marginal-cost pricing, because natural water is in short supply. Suppose that only thirty-two units of natural water is available. Due to system leakage and evaporation, the relationship between natural water pumped and retail water received is

$$w_{rtl} = \frac{w_{ntrl} - 10}{1.1}.$$

What is the value of an action to increase natural water availability to forty-three units? Sketch an appropriate graph for this change and calculate the added net benefits.

4. If a water policy alters the profitability of a land-based production activity (like farming) by changing water rates or available water quantity, and if the net benefits of this profit change are well measured, should we also include in net benefits the policy's effect on property values? (Reflect upon Appendix 3.A in chapter 3.)

5. A new supply-shifting policy of the state will have three direct effects in a specific river basin experiencing scarcity:

- Supply will be shifted rightward for Upriver City; the net benefits of this shift to all of the city's water users has been estimated to be \$5 million. The additional water use will result in the production of an added \$2 million in output (market value). With a

conservatively estimated multiplier of 2.3, secondary economic effects will amount to \$4.6 million in the city.

- Supply will be shifted leftward for Downriver Irrigation District; the properly measured net “benefits” of this shift across all district irrigators is –\$2 million. The value of farm output will be lowered by \$1 million in the district. The secondary effects multiplier for the farm sector is 2.5.
- Between the city and the district is a river segment which will suffer some environmental degradation as a result of decreased flow. Some of these losses have been competently valued at \$500,000. The remainder of the losses have not been valued.

Is this a desirable policy for the river basin? Discuss your observations and reasoning.

6. The Town of Agton's water utility engages in average-cost pricing. Across the community the average consumer pays \$1.60 per thousand gallons. In the average year, Agton collects just enough water revenues to cover all its costs of providing water. Annual water use averages  $1.8 \times 10^9$  gallons. As the town's analyst, you believe that marginal costs would be \$2 if marginal-cost pricing was in effect, and you estimate that average annual consumption would then be  $1.7 \times 10^9$  gallons. Also, based on your knowledge of operating costs, every million gallon increase/decrease in water sales adds/subtracts \$0.001 to/from marginal costs and \$0.0005 to/from average costs.

Agton is courting a major industrial business, KCorp, and the mayor is hopeful that the business will choose to locate a processing facility in Agton. If it does, Agton has promised to charge KCorp no more than \$1.50 per thousand gallons, and KCorp has told the town to expect it to take  $0.2 \times 10^9$  gallons per year at this price. Analyze the effects of KCorp's arrival in Agton by taking the following steps:

- a. Provide a relatively accurate illustration of the supply-demand situation, including shifting demands, AC and MC functions, and consumer welfare areas.
- b. Calculate the complete impact of ZCorp's water use on existing consumers.

7. A well managed Aquifer Authority (AA) understands that the water it manages is being depleted. Residents of the region (several towns and cities, many irrigators) voted to grant AA the power to meter and regulate pumpage. AA decided to rely on a pair of policies and has been conducting them for several years: (1) each year MUC is computed and all ground water users must pay this charge on every unit of pumped water and (2) AA has been aggressively investing this revenue because it will eventually apply its funds to the development of surface water supplies when the time is right. Things have been operating smoothly even though the MUC charge is publicly disliked.

A new problem caused by a doubling of the market price of oil has recently occurred. This has raised the value of biofuels, especially ethanol, and caused large increases in both irrigated corn acreage and irrigation pumping.

Discuss and illustrate the implications of this change for the rate of depletion and AA's two policies. In your judgment, do the new conditions pose a policy disappointment and why/not?