TEAMS Competition 2014

Scenario #

Urban Green Space Design

Solutions to Multiple Choice Problems

1. The GS_C added due to the proposed project on a square foot per capita basis is closest to:

   a. 14 b. 22 c. 1 d. 8 e. 199

   ANSWER: d

   SOLUTION: First find the added square footage of each corridor.

$$Area\ Corridor\ 1 = (6300ft * 21ft) = 132{,}300\ ft^2$$
$$Area\ Corridor\ 2 = (16380ft * 15ft) = 245{,}700\ ft^2$$
$$Area\ Corridor\ 3 = (3696ft * 24ft) = 88{,}704\ ft^2$$
$$Area\ Corridor\ 4 = (520ft * 25ft) = 13{,}000\ ft^2$$
$$Area\ Corridor\ 5 = (8976ft * 17ft) = 152{,}592ft^2$$

   The sum of individual corridor areas is:

   132,3000 ft^2 + 245,700 ft^2 + 88,704 ft^2 + 13000 ft^2 + 152,592 ft^2 = 632,296 ft^2

   The GS_C is then:

$$\frac{632{,}296\ ft^2}{81{,}247\ persons} = 7.78\ ft^2$$

   The result is closest to 8 square ft per capita

2. If the proposed corridor project is developed, what additional minimum amount of green space would need to be developed in the future to meet the GS_C requirement of 1 acre for every 200 residents?

   a. 21 acres b. 6 acres c. 40 acres d. 100 acres e. 392 acres

   ANSWER: a.

   SOULTION:
   Step 1. Determine the total amount of acreage required for the population at the GSC requirement:

$$\frac{1\ acre}{200\ residents} = \frac{x\ acres}{81{,}247\ residents}$$

$$\therefore x = 406.24\ acres$$

   Step 2. Compare the current amount of acreage to the requirement to find the amount of additional acres required.

   406.24 acres – 371 acres = 35. 235 additional acres required.

   Step 3. Determine the amount of acreage contained within the individual corridors.

$$Area\ Corridor\ 1 = (6300ft^2 * 21ft)\frac{1\ acre}{43560\ ft^2} = 3.04\ acres$$
$$Area\ Corridor\ 2 = (16380ft^2 * 15ft)\frac{1\ acre}{43560\ ft^2} = 5.64\ acres$$
$$Area\ Corridor\ 3 = (3696ft^2 * 24ft)\frac{1\ acre}{43560\ ft^2} = 2.04\ acres$$
$$Area\ Corridor\ 4 = (520ft^2 * 25ft)\frac{1\ acre}{43560\ ft^2} = 0.30\ acres$$
$$Area\ Corridor\ 5 = (8976ft^2 * 17ft)\frac{1\ acre}{43560\ ft^2} = 3.50\ acres$$

   Step 4. Sum the acreage of individual corridors to come up with a total acreage

   3.04 + 5.64 + 2.04 + 0.30+ 3.50 = 14.52 acres.

Step 5. Subtract 35.24 acres needed from 14.52 acres new development to find 20.72 acres more needed.

3. The percent decrease of GS_P due to the proposed project is closest to:

a. 15%
b. 57%
c. 82%
d. 63%
e. 44%

ANSWER: b

SOLUTION: Current GSD is 2200 ft
New GSD following development is 975 ft

% decrease due to development is

$$\left[\frac{(2200-975)}{2200}\right] * 100 = 55.7\%$$

4. Using the data found in Table 1 and the planned percent of the new development that will be unmaintained landscape, the total acreage of undeveloped habitat area based upon the proposed development is:

a. 6.0
b. 22.7
c. 14.5
d. 12.8
e. 2.7

ANSWER: a

SOLUTION

A total of 14.52 acres of new green corridor is planned. If the corridor is 41% unmaintained land, then the amount of undeveloped habitat area is 14.52*0.41 = 5.95%

5. If one section of the development replaces a 300 ft segment of a 4 ft wide concrete side walk with a gravel path, the anticipated decrease in runoff volume for a 1 inch precipitation event is approximately:

   a. 5 ft^3 d. 60 ft^3
   b. 30 ft^3 e. 120 ft^3
   c. 250 ft^3

   ANSWER: d

   SOLUTION:

   The volume of runoff from concrete sidewalk is:

$$V = 1200ft^2 * \left(\frac{\left[1 - 0.2\left(\frac{1000}{98} - 10\right)\right]^2}{1 + 0.8\left(\frac{1000}{98} - 10\right)} \right)\left(\frac{1\ ft}{12\ in}\right) = 79.16\ ft^3$$

   The volume of runoff from gravel sidewalk is:

$$V = 1200ft^2 * \left(\frac{\left[1 - 0.2\left(\frac{1000}{85} - 10\right)\right]^2}{1 + 0.8\left(\frac{1000}{85} - 10\right)} \right)\left(\frac{1\ ft}{12\ in}\right) = 17.36\ ft^3$$

   The difference between the two volumes is 79.16 – 17.36 = 61.8, which is close to 60 ft^3

6. By examining the SCS runoff volume equation, a relationship between CN and runoff volume can be inferred. If the CN decreases, the runoff volume will:

   a. increase only if precipitation increases
   b. decrease only if precipitation increases
   c. increase regardless of precipitation
   d. decrease regardless of precipitation
   e. not change

ANSWER: d
SOLUTION: as CN gets smaller the runoff volume decreases regardless of precipitation

7. They city engineers estimated the total construction costs for the proposed project to be $5 million. If the project has a 20 year service lifespan (the amount of time the project will be used and maintained) and an annual interest rate of 8% compounded yearly is assumed, the annualized cost of the construction portion over the 20 year timeframe is closest to:

   a. $500,000
   b. $250,000
   c. $750,000
   d. $100,000
   e. $1,000,000

   ANSWER: A

   SOLUTION: $A_P = 5x10^6 \left[\frac{0.08}{1-(1+0.08)^{-20}}\right]$ = $509,261 /yr

8. The city engineers also plan a one-time cost to completely re-gravel the entire corridor during year 10 of the projects anticipated lifetime. The engineers estimated the cost of the re-gravelling effort 10 years from now to be $750,000. If the project has a lifespan of 20 years and an annual interest rate of 8% compounded yearly is assumed, the annualized cost of the future re-graveling effort is approximately:

   a. $10,000
   b. $20,000
   c. $90,000
   d. $75,000
   e. $35,000

   ANSWER: E

   SOLUTION: $A_F = \$750{,}000\left[\frac{1}{(1+0.08)^{10}}\right] * \left[\frac{0.08}{1-(1+0.08)^{-20}}\right] = \$35{,}383\ /yr$

9. The city planning commission received a bid from a construction firm that estimated the initial cost of the gravel path installation to be 1.5 million US dollars. The bid also included a re-graveling cost of 700,000 dollars in year 10. The company also included a cost estimate for a gravel path maintenance cost of $50,000 per year and a routine inspection cost of $5,000 per year. Based upon these cost projections, the annual worth of the project is:

   a. $182,000/yr
   b. $94,000/yr
   c. $590,000/yr
   d. $241,000/yr
   e. $72,000/yr

   ANSWER: D

   SOLUTION:

   First solve for A_P

   $A_P = 1.5x10^6\left[\frac{0.08}{1-(1+0.08)^{-20}}\right]$=$152,778

   Next solve for A_F

$$A_F = \$700{,}000\left[\frac{1}{(1+0.08)^{10}}\right] * \left[\frac{0.08}{1-(1+0.08)^{-20}}\right] = \$33{,}024\ /yr$$

Next sum up Annual Operating Costs

50,000 + 5000 = 55000

Finally add AP + AF + AOC = 152,778 + 33,024 + 55000 = $240,802

10. The city planning commission received a second bid with an annual worth projection of - $138,000 per year. If the project is developed, the city expects $60,000 per year of revenues from increased amphitheater sales and $27,000 per year revenue from increased festival related sales. The city also expects to generate increased revenue from property taxes, as property values surrounding green spaces increase. How much annual tax revenue must the project generate each year to pay for itself?

a. $160,000
b. $14,000
c. $11,000
d. $51,000
e. $72,000

ANSWER: D

SOLUTION: Add each of the proposed annual revenues from the AW projection to determine the annual surplus or shortfall.

-138,000 + 60,000 + 27,000= -51,000.

That means that the annual tax revenue must be at least +51,000 to break even.