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Daybreak Community Landscape Performance Benefits Assessment

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Daybreak Community

TRADITIONAL



SUSTAINABLE



Landscape Performance Benefits

- Retains 100% of storm water that falls on the site for up to a 100-year storm with no impacts on or connections to the municipal storm sewer system.
- Saves approximately 1.5 million gallons of potable water each year by using an innovative drip irrigation design. Projected annual savings at build-out are 18.7 million gallons, saving approximately \$54,000 annually.
- Promotes species diversity with nearly 2.5 times the national average for comparable wetland bird populations present in man-made Oquirrh Lake and the surrounding wetlands.
- Reduces auto trips with 88% of neighborhood students currently walking or riding bikes to school. This is expected to reduce auto trips by 2.3 million miles a year at build-out, saving 102,00 gallons of fuel and reducing carbon emissions by 950 tons annually.
- Reduced carbon footprint by 9,110 tons, saved 23,000 gallons of fuel and saved over \$1.6 million in concrete and transportation costs by reusing materials onsite and recycling construction waste.

Overview

Daybreak is a 4,127-acre model mixed-use community for comprehensive sustainable design. The project was planned on surplus mining land and will accommodate over 20,000 residential units, approximately 9.1 million sf of commercial space, and 20,000 jobs at build-out. The extensive parks and open space integrates stormwater management, merges with natural systems, and is enlivened by social and recreational programming. The full range of sustainable features includes walkable streets, an extensive trail system, native and drought-tolerant plants, habitat conservation, recycled materials, and a vibrant mix of amenities and services.

Sustainable Features

- Of the 4,100 acres in the entire development, up to 1,000 will be used for parks and open space. 120 acres of parks and open space have been dedicated so far.
- Daybreak boasts 22 miles of maintained trails and every home is within 1/4 mile of the trail system.
- The onsite stormwater management system includes 65-acre man-made Oquirrh Lake, 25 acres of constructed wetlands, stormwater canals, dry wells, infiltration basins, and roadside bioswales.
- Oquirrh Lake retains stormwater and supplies reserve irrigation water while providing habitat to over 59 species of birds and game fish.
- Native plant communities comprise 68% of common open space, and drought-tolerant plants cover at least 40% of every residential lot. Manicured turf is limited to recreation fields.
- Terraced demonstration gardens display the beauty of native species and teach residents about responsible landscape methods within the Great Basin ecology.
- Material excavated to create the lake was reused onsite as base for roads, saving on materials and hauling costs.

Designer

Design Workshop, Inc.

Land Use

Greenfield
Mixed-use

Project Type

Community
Stormwater management facility

Location

4454 West Harvest Moon Drive
South Jordan, Utah 84095

Size

4,127 acres

Budget

\$4.3 million - Design and consultation fees; \$48-63 million - Landscape construction costs to date

Completion Date

2004 - Founders Village; 2025 - Project buildout

- Recycled mine rock from the adjacent Kennecott copper mine is used for walls and entrance monuments throughout the community.
- Community garden space is being expanded due to popular demand.

Challenge

The design team was challenged to create a new community in a high desert environment where traditional, water-intensive development and manicured landscapes are not sustainable. In order to meet local stormwater regulations, appeal to potential home buyers, and fit the environmental context, public parks and open space needed to be both visually engaging and serve sustainable functions.

Solution

Through collaborative, holistic planning an intentional, sculpted parks and open space system was designed to perform multiple functions. On-surface stormwater management is integrated and serves to create habitat, supplement irrigation, and enhance recreation opportunities. The design merges natural systems, social and recreational spaces, and stunning visual amenities.

Cost Comparison

- Engineers estimate over \$70 million in storm water infrastructure savings over the life of the Daybreak project due to the elimination of municipal impact fees and the dramatic reduction in conventional conveyance infrastructure. This estimate includes \$30 million in residential impact fees, residential entitlements by owner, and reduced in-ground infrastructure.
- Using on-site nursery acclimation, species and age diversity and tree-by-tree computer-chip monitoring reduces tree mortality by 60% over typical rates, saving an estimated \$2 million in replanting costs for the project goal of 100,000 trees planted.

Lessons Learned

- When planned in a collaborative, holistic way, parks and open space systems can perform multiple social, ecological and economic functions. The landscapes at Daybreak capture storm water, nurture habitat, facilitate recreation, provide a stunning visual amenity, increase land values, and promote social interactions.

Project Team

Client/Owner: Kennecott Land Residential Development Company
Community Master Planner: Calthorpe Associates
Landscape Architecture: Design Workshop, Inc.
Civil Engineers: Nolte Associates, Stantec
Irrigation Designer: Russ Jacobsen, LLC
Electrical Engineers: Envision Engineering, Hunt Electric
Wildlife Biologist: Craig Johnson LLC
Contractors: ValleyCrest Nursery, Progressive Plants

Role of the Landscape Architect

Design Workshop completed master plans for the 4,200-acre community's parks and open space system, produced concept through construction drawings for 65-acre Oquirrh Lake and accompanying open space systems (an additional 100 acres), produced concept through construction documents for the Founder's Village parks and open space system including on-surface stormwater conveyance and infiltration, and has continuing design and construction projects throughout the community.

Case Study Prepared by:

Research Fellow: Bo Yang, PhD, Assistant Professor, Utah State University
Research Assistant: Amanda A. Goodwin, MLA Candidate, Utah State University
August 2011

References & Resources

Design Workshop - Daybreak

Kennecott Land - Daybreak

National Association of Home Builders Community of the Year, 2011

National Association of Home Builders Best in American Living Platinum Award, 2011

Envision Utah Governor's Quality Growth Award, 2010

RCLCO Sixth fastest selling community in the state of Utah, 2010

ASLA Utah Honor Award, 2008

American Concrete Institute Excellence in Concrete Award, 2007

Envision Utah Governor's Quality Growth Award, 2006

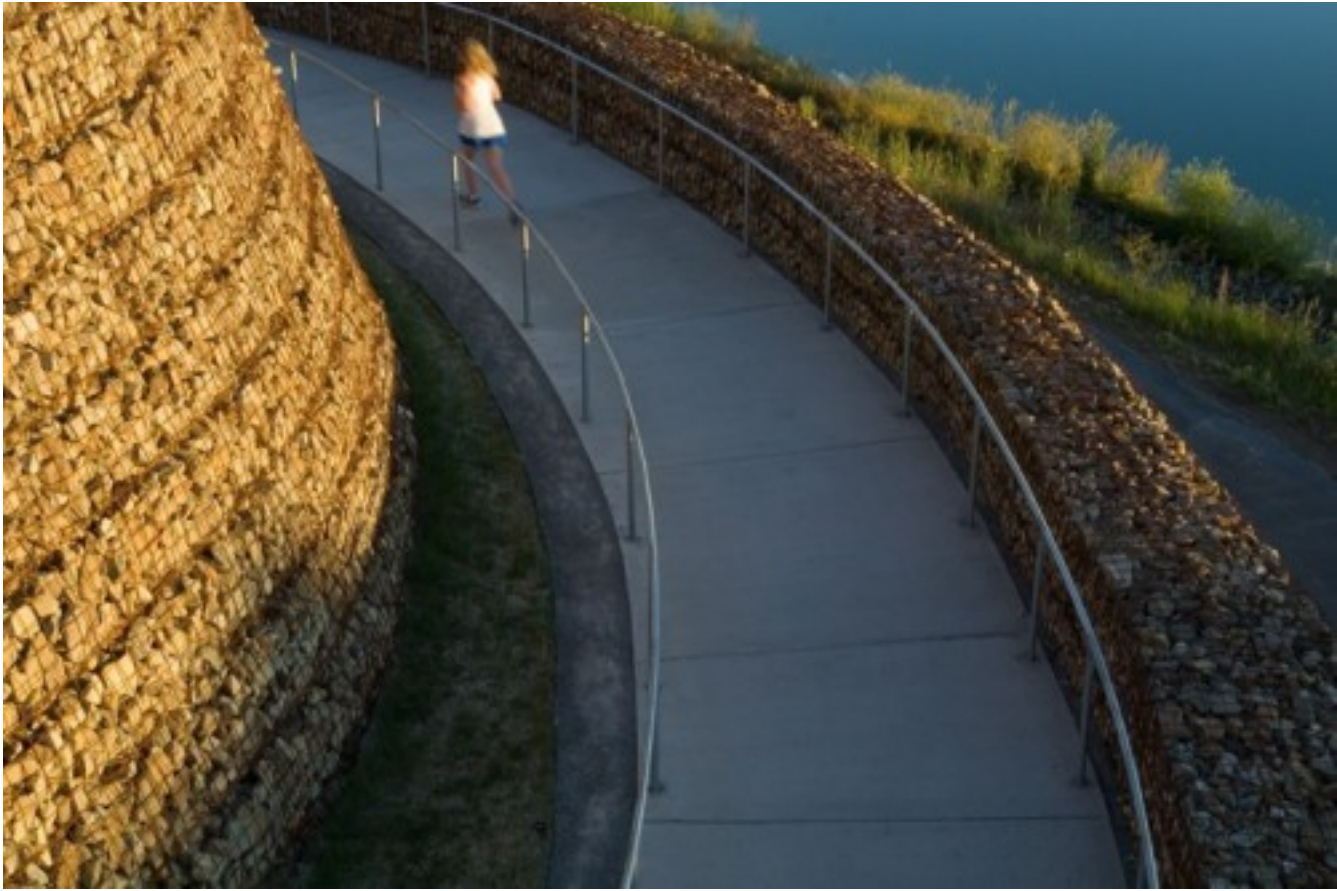
Envision Utah Governor's Quality Growth Award, 2002

Additional Images





















LANDSCAPE PERFORMANCE SERIES

Daybreak Community Methodology for Landscape Performance Benefits

- ***Retains 100% of storm water that falls on the site for up to a 100-year storm with no impacts on or connections to the municipal storm sewer system.***

Verified by civil engineer, Nolte and Associates. All storm water is directed to on-site swales, constructed wetlands, dry wells and/or infiltration basins in the parks and open space system to supplement irrigation and to cleanse and infiltrate the water. The storage capacity of these combined systems is greater than the volume generated in post-construction conditions up to and including the 100-year storm event. There are no connections to the South Jordan municipal stormwater sewer system. In the case of a greater than 100-year storm event, excess water tops designated street curb locations and utilizes the street cross-section for storage and movement of water through South Jordan and into the Jordan River.

- ***Saves approximately 1.5 million gallons of potable water each year by using an innovative drip irrigation design. Projected annual savings at build-out are 17.2 million gallons, saving approximately \$54,000 annually.***

Worst-case water use calculations were obtained from Design Workshop and used to represent “typical” water use of surrounding communities. 10% of this number was used to estimate the gallons saved through “10% efficiency” drip irrigation technology.

Build-out is expected by 2025, and Daybreak is currently only at 8% of build-out. Projections were calculated by multiplying current savings by a ratio and then by current South Jordan water rates:

Worst case water use per year: 14,973,899 gallons of potable water used for current built portion of Daybreak (Design Workshop, 2004).

$14,973,899 \times 0.10 = \mathbf{1,497,390 \text{ gallons of potable water per year saved}}$

Projected annual water savings for 100% build-out:

$1,497,390 \times 100/8 = \mathbf{18,717,375 \text{ gallons saved annually at full build-out}}$

Water saved is multiplied by South Jordan water billing rates (HOA area C):

\$2.90 per 1,000 gallons (South Jordan City, 2011)

$18,717,375 \times \$2.90/1,000 = \mathbf{\$54,280 \text{ annual savings at build-out using 2010 water rates.}}$

- ***Promotes species diversity with nearly 2.5 times the national average for comparable wetland bird populations present in man-made Oquirrh Lake and the surrounding wetlands.***

Typical wetlands of similar ecotype were researched to obtain an estimated average bird populous. This value was compared to the bird counts performed at Oquirrh Lake by the Audubon Society and presented as a proportion (Kantrud, 1984). Acres of wetland created was provided by published Design Workshop literature.

- ***Reduces auto trips with 88% of neighborhood students currently walking or riding bikes to school. This is expected to reduce auto trips by 2.3 million miles a year at build-out, saving 102,000 gallons of fuel and reducing carbon emissions by 950 tons annually.***

To calculate trip miles saved, average number of households with children were estimated and multiplied by the 1/4 mile rule, over the number of days in a typical duration of education per year:

20,000 residential units at build-out @ 71.8% with children (US Census Bureau, 2011)
 20,000 x .718 = 14,360 families
 1/2 mile return-trip drive, 2 times daily for 180 days each year (US Department of Education, 2002)
 $1/2 \times 2 \times 180 \times 14,360 = 2,584,800$ trip miles driven annually at build-out

A study by the University of Utah Department of Family and Consumer Studies and published in the Journal of Environmental Psychology in the fall of 2010 (Napier et al., 2011) shows that 88% of students walk to school.

88% reduction = $2,584,800 \times .88 = 2,274,624$ trip miles saved

Current average U.S. auto efficiency is 22.4 mpg

$2,274,624 / 22.4 = 101,545$ gallons of fuel saved

To calculate carbon footprint reduction from trip loads, trip distance was entered into the ALG Carbon Calculator, by using the metric of a midsize petroleum engine (Future Climate, 2011)

Use ALG Carbon Calculator divide trip distance by 52 and provide vehicle fuel efficiency rate

- ***Reduced carbon footprint by 9,110 tons, saved 23,000 gallons of fuel and saved over \$1.6 million in concrete and transportation costs by reusing materials onsite and recycling construction waste.***

Carbon footprint reduction was calculated by first researching manufacturing average carbon dioxide emissions per ton of concrete. This value was multiplied by the amount of concrete reported as recycled by the client:

Total concrete needed provided by Client: 1,600 tons
 Total CO2 emissions per ton of cement = 1.1 tons (Malhotra, 1998)
 $1.1 \times 1,600$ tons needed = 17,600 tons of carbon avoided by using recycled materials

Trip load impact was added to the equation by first calculating the ratio of cement to concrete, then by researching typical carrying capacities of payload trucks and dividing total amount needed by this volume. To obtain number of trips needed, feasible cement and concrete manufacturing plants were located and total distance was calculated by adding number of trips needed from cement to concrete plant, and from concrete plant to project site.

1,600 tons of concrete needed = 22,068 cubic yards
 Ratio: 6 bags of Portland cement to 1 cy of concrete
 $6 \times 22,068 = 132,408$ bags

Each bag weighs 97 lbs (Malhotra, 1998). Payload truck can carry 75,000 lb.
 $75,000 / 97 = 773$ bags per trip
 $132,408 / 773 = 171$ trips from cement plant to concrete plant

106 miles each way from cement to concrete plant (x 2 round trip) = 212 miles per trip
 $212 \times 171 = 36,252$ trip miles

Typical concrete mixer truck can carry 10 cy of concrete
 $22,068 / 10 = 2,207$ trips needed

5.5 miles each way from nearest feasible concrete plant to Daybreak = 11 miles per trip
 $11 \times 2,207 = 24,277$ trip miles
 $36,252 + 24,277 = 60,529$ total trip miles for specifying new concrete

This process was repeated to include the amount of recycled construction waste that was reused onsite rather than being shipped to a recycling center: Total volume of waste was divided by typical carrying capacity of a one-ton dump truck, then multiplied by the return-trip distance to the nearest feasible recycling center. Total distance between trips for concrete and waste recycling was entered in to a carbon calculating software program. Finally, trip impact carbon reduction and cement product carbon reductions were summed to calculate total carbon impact reduction.

43,500 tons or 87,000,000 lbs of crushed rock reused
Crushed rock = $2,200-2,700$ lb /cy = 32,222 cy on average

Typical dump truck capacity is 5 cy (assuming 8 mpg diesel truck)
 $32,222 / 5 = 6,444$ trip loads needed

10 miles to nearest rock recycling business (x 2 for round trip) = 20 round trip distance
 $20 \times 6,444 = 128,888$ trip miles needed

$60,526 + 128,888 = 189,414$ total trip miles avoided by recycling onsite construction waste and rock

Fuel savings were estimated by multiplying total trip distance between concrete importation and waste exportation at 8 mpg diesel rate. Divide total trip distance by /mpg fuel efficiency for gallons of fuel needed.

Typical diesel v8 truck @ 8mpg
 $189,414 / 8 = \mathbf{23,676}$ gallons of fuel saved

Current fuel prices for diesel were estimated at \$3.56 / gallon (for 2010).
 $23,676 \times 3.56 = \$84,287$ in fuel cost savings

Material savings were estimated by researching concrete prices and multiplying average cost of concrete by total amount of recycled concrete.

$\$70 \times 22,068 = \$1,544,760$ in material cost savings

$84,287 + \$1,544,760 = \mathbf{\$1,629,047}$ total savings

Cost Comparison

- ***Engineers estimate over \$70 million in storm water infrastructure savings over the life of the Daybreak project due to the elimination of municipal impact fees and the dramatic reduction in conventional conveyance infrastructure. This estimate includes \$30 million in residential impact fees, residential entitlements by owner, and reduced in-ground infrastructure.***

Calculations generated by civil engineer, Nolte and Associates.

- ***Using on-site nursery acclimation, species and age diversity and tree-by-tree computer-chip monitoring reduces tree mortality by 60% over typical rates, saving an estimated \$2 million in replanting costs for the project goal of 100,000 trees planted.***

Typical tree mortality rates were researched and compared to those reported by annual Daybreak on-site nursery inventory. The difference between the two is presented as a ratio of reduction.

Daybreak mortality rate: 4-5% vs. typical mortality rate at 10-12% (Ulam, 2010)
 11% (national avg.) – 4.5% (avg. in Daybreak)/ 11%= **60% mortality reduction**

Cost savings were calculated by first researching typical installation prices of installed 2" balled and burlapped trees from local nurseries. Difference in mortality was multiplied by the projected 100,000 trees to be planted at Daybreak (RioTinto, 2010), and then by the typical installation price of balled and burlapped tree installation. Finally, the cost of microchip materials and installation costs was subtracted from this number for a total cost savings.

100,000 trees at typical mortality rates of 10-12% = 11,000 trees to replace
 100,000 trees at Daybreak mortality rates of 4-5% = 4,500 Daybreak trees to replace
 11,000 – 4,500 = 6,500 trees that would otherwise have to be replaced

Typical 2" balled and burlapped tree, installed from Daybreak Contactor bids = \$360
 6,500 x \$360 = \$2,340,000 cost savings from tree replacement

\$3 microchip per tree = \$300,000 cost investment
 \$2,340,000 – \$300,000 = **\$2,040,000 savings**

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