# Green Space Rate Study

Presented to:

***City of Denver, Colorado***
***Department of Public Health and Environment***
**200 West 14th Avenue, #310**
**Denver, CO 80204**

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# I. EXECUTIVE SUMMARY

The Green Roof Initiative was passed by the City of Denver voters in the fall of 2017 and took effect on January 2018. It mandates that every building and roof replacement of a building 25,000 square feet or larger, or a building addition that results in a building 25,000 square feet or larger, include a green roof or a combination of green roof and rooftop solar or solar panels. It also mandates that any building of that size install a combination of a green roof and solar panels at the time of roof replacement.

The City organized a task force to help refine the initiative. In June of 2018, the task force suggested eight potential compliance options from which to choose in fulfilling the green roof requirement. One of the options is an in-lieu fee. This analysis examines and recommends an appropriate in-lieu fee rate to which the in-lieu fee would be derived. The in-lieu rate must be rationally related to the overall cost for the City to provide an equivalent benefit.

The scope of work defined for the in-lieu rate study is as follows:

- The study would show the cost the City would incur to install equivalent required green space on the ground as what would have been required to be installed on the building site to comply with the proposed Green Building policy. It would include items such as land value, construction, and operations and maintenance. Land costs are included because the rate has to be reasonably connected to the cost for the City to supply the service and land purchases are sometimes potentially needed.
- The study should also show the cost for the City to install an equivalent sized green roof as what would have been required to be installed on the building to comply with the proposed Green Building policy. The cost for installing a green roof should include items such as construction, operations and maintenance.
- Because the City will be administering the funds, the rate study will determine the necessary administrative costs of the City.
- The cost should be based on City pricing, not private pricing. The cost of an equivalent project contract with the City is often higher than the cost to a private developer because of City labor law and other requirements.
- The rate should also include a recommendation regarding how the fee should best be increased in the future with a formula tying it to an index / value that is measured regularly.

**The in-lieu rate recommended is $50 to $90 per square foot for the required green area. The in-lieu fee would be the Rate* one of the following options (whichever is least)**

- 1. Ten percent (10%) of the floor area of the building;
- 2.Sixty percent (60%) of the total roof area on the building; or
- 3.The available roof space on the building.

The rate recommended is based on a compilation of costs including the following:

- Land Values (Costs)
- Capital Costs (Construction)
- Operations and Maintenance
- City Administrative Costs

**Figure 1**
**Denver Land Values**

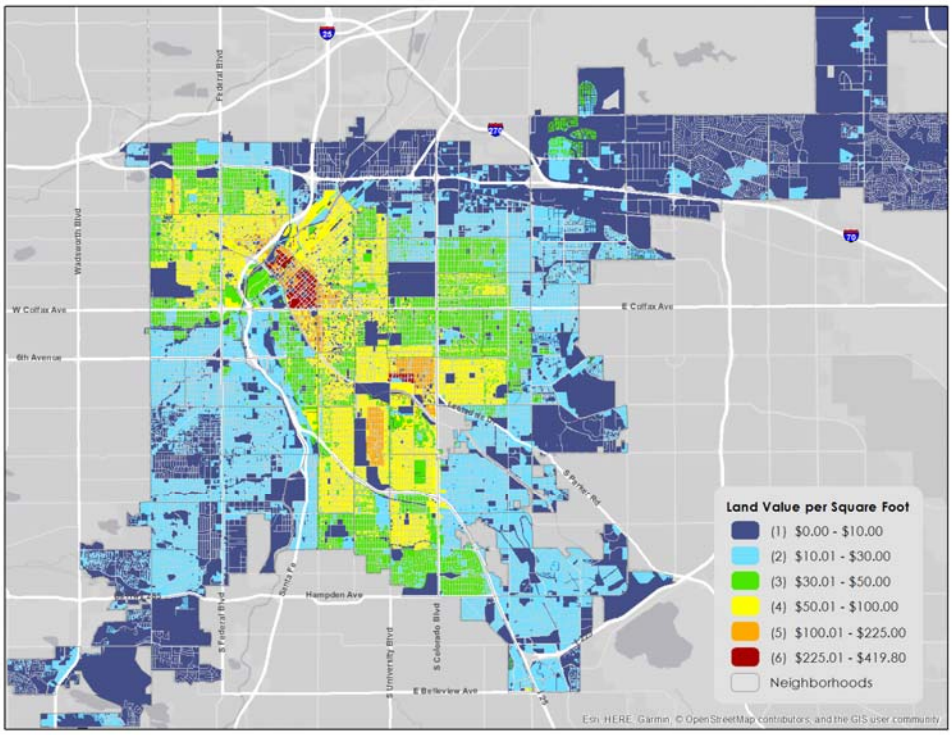
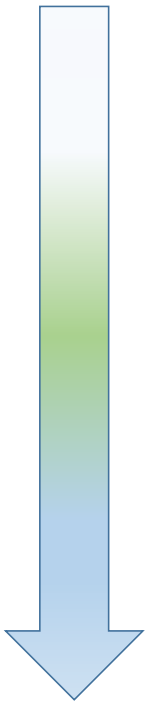



**Figure 2**
**The In-Lieu Rate Cost Menu**

| Land | Capital Costs | Operations & Maintenance |
|---|---|---|
| • City owned property - $0<br>• Area 1 - $5<br>• Area 2 - $20<br>• Area 3 - $40<br>• Area 4 - $75<br>• Area 5 - $163<br>• Area 6 - $323 | • Construction<br>  • Suburban park including significant natural areas - $5<br>  • Extensive basic green roof - $25<br>  • Landscaping (no hardscape, soil, etc.) - $25<br>  • Urban green space - $35<br>  • Green infrastructure - $50 to $80<br>  • Water quality - $95<br>  • Extensive landscaping, soil mitigation and hardscape in downtown - $200 to $350<br>• Admin<br>  • Park PM - $0.30<br>  • Green Infrastructure PM - $4.15 | • Admin<br>  • Interdepartmental staff oversight - $2.48<br>• O&M<br>  • Basic landscaping to intensively used urban park - $4.67 to $11.00 |

Source: ArLand

**Figure 3**
**Example Equivalent Benefit Projects and Costs**



| Equivalent Benefit | $ PSF | Example Projects |
|---|---|---|
| | $ 15 | Suburban park in Area 1 |
| | $ 30 | Extensive green roof on City property ($0 land value) [1] [2] |
| | $ 30 | Landscaping (no soil mitigation / hardscape) on $0 land value property [1] |
| | $ 30 | Suburban park in Area 2; land availability challenge |
| | $ 35 | Landscaping (only) in Area 1 |
| | $ 45 | Intensive green roof on City property ($0 land value) [2] |
| | $ 50 | Urban green space on $0 land value property [1] |
| | $ 60 | Green infrastructure additions (low) on $0 land value property [1] |
| | $ 70 | Urban green space in Area 2 ; land availability challenge |
| | $ 90 | Green infrastructure additions (high) on $0 land value property [1] |
| | $ 90 | Urban green space in Area 3; land availability challenge |
| | $ 100 | Green infrastructure additions (low) in Area 3 |
| | $ 125 | Urban green space in Area 4; land availability challenge |
| | $ 135 | Green infrastructure additions (low) in Area 4 |
| | $ 165 | Green infrastructure additions (high) in Area 4 |
| | $ 210 | Urban green space in Area 5; land availability challenge |
| | $ 220 | Green infrastructure additions (low) in Area 5 |
| | $ 255 | Green infrastructure additions (high) in Area 5 |
| | $ 370 | Urban green space in Area 6; land availability challenge |
| | $ 385 | Green infrastructure additions (low) in Area 6 |
| | $ 535 | Mature landscaping, soil mitigation and hardscape in Area 6 |

Source: ArLand, based on Denver metro area contractors, City of Denver, Denver County Assessor

[1] $0 land value properties include City owned properties and area within City Rights of Way

[2] Does not include costs of retrofitting existing roofs on City buildings to accommodate green roofs

The recommended in-lieu rate is based on:

- *Land Value:* The value of land depends on the location in the City, allowable uses, and other market factors. It assumes that land for an equivalent benefit project would need to be purchased in a private land transaction. Land values in Denver were divided up into categories (Areas 1-6) based on value. A mid-point of each range serves to represent each area. Land values and geographies are shown in Figure 1.
- *Capital Cost*: Capital costs are based on the project type as shown in the blue box in Figure 2. Appropriate administrative costs should also be included. A parks project is estimated at $.30 per square foot in project management costs while a green infrastructure project is $4.15 per square foot. The disparity in costs is due to the scale of the typical project; Parks are often acres in size and include natural areas (which need no management) whereas green infrastructure projects are typically small in scale, but have a large benefit.
- *Operations and Maintenance*: Interdepartmental staff oversight costs are always included at $2.48 per square foot. Depending on the project type (parks or infrastructure), an Operations and Maintenance figure is applied to the in-lieu rate. A less intensive use is equivalent to $4.67 per square foot while a more actively used scenario is $11.00 per square foot.

The recommended in-lieu rate range is $50 per square foot up to $90 per square foot representing the most realistic projects the City would undertake.

- At $50 to $90 per square foot, the City could develop small, urban public green spaces on City owned land or in outlying neighborhoods. Projects could include:
    - Plaza
    - Transit stop
    - Green infrastructure (stand alone)
    - Pocket park
    - Etc.
- Green infrastructure projects can be incorporated in City Rights of Ways or on public lands, or can be leveraged on to existing transportation mobility or other public infrastructure projects
- Depaving projects in highly impervious areas

While there are potential projects at $20-$45 per square foot and above $100 per square foot, they are either unrealistic or would be projects that the City would likely not undertake.

Construction costs are the primary components of the rate recommended. **It is recommended that the City evaluate and determine whether the rate should be increased every year (or decreased) based on the Mortenson Construction Cost Index for the Denver Metro area.** After examining several indices, it was determined that it did the best job in mirroring the local increases in the industry that would have an impact on how the City provides equivalent benefit.

## II. BACKGROUND

The Green Roof Initiative was passed by the City of Denver voters in the fall of 2017 and took effect on January 2018. It mandates that every building and any roof replacement of a building 25,000 square feet or larger, or a building addition that results in a building 25,000 square feet or larger, include a green roof or a combination of green roof and rooftop solar or solar panels. It also mandates that any building of that same size install a combination of a green roof and solar panels at the time of roof replacement.

The City organized a task force to help refine the initiative to address potential inequities and to provide property owners choices in how they fulfill the initiative's intent. The Green Roofs Review Task Force's mission was to recommend modifications, clarifications, and improvements to the Green Roof Ordinance through a collaborative, consensus-based process that honored the vote and the benefits that the ordinance would have achieved. The Green Roofs Review Task Force met nine times from January 19, 2018, through June 7, 2018.

Members reached consensus in their final meeting on a proposal they believe strengthens the existing ordinance while improving flexibility and allowing property owners and builders cost-effective ways to achieve the benefits and intent of the original Green Roof ordinance. The task force suggested eight potential compliance options for new buildings (Figure 4) and five for existing buildings (Figure 5) from which to choose from in fulfilling this requirement.

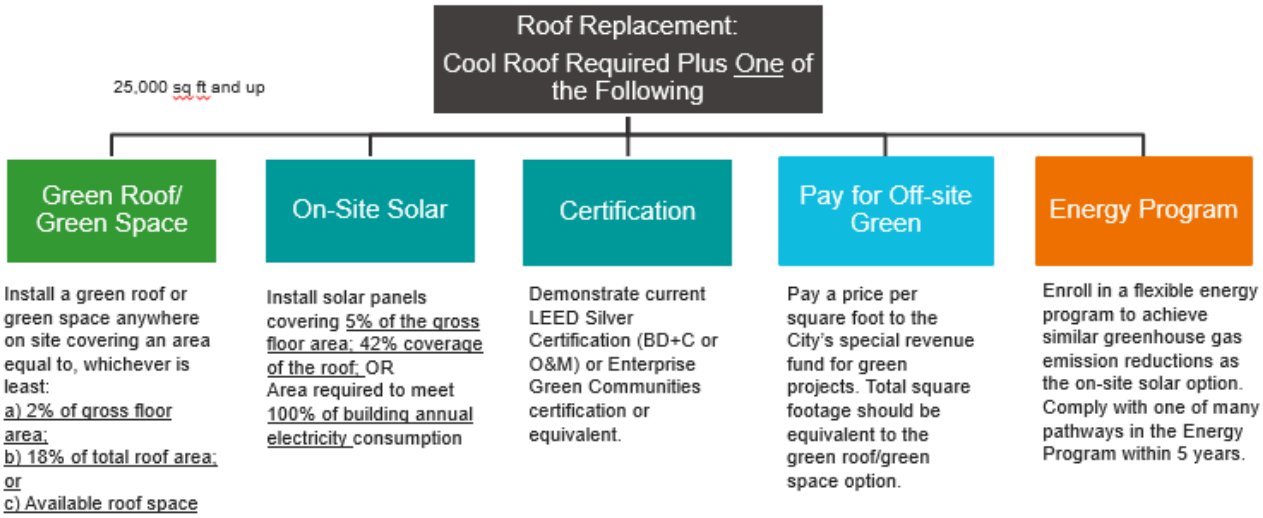
**Figure 4**
**New Building Compliance Options**

| **Green Roof / Green Space** (roof, terraces, podiums, grade-level) | **Green** (roof, terraces, podiums, grade-level, off-site) ***and*** **Solar** (roof, building, site, community) | **Solar** (roof, building, site, community) | **LEED v4 BD+C Certification** |
|---|---|---|---|
| Green area equivalent to whichever is least:<br>a) 10% of gross floor area;<br>b) 60% of the total roof area; or<br>c) Available roof space | Green area equivalent to:<br>3% of gross floor area; 18% of total roof area; or available roof space – whichever is least) AND<br>On-site renewable energy or community solar total system production equivalent to:<br>7% of roof area x no. of floors (max 42% of roof area required) | On-site renewable energy or community solar or Xcel Renewable Connect for a total system production equivalent to:<br>70% of roof area | Minimum Gold level certification |
| **Financial contribution** for off-site green space | **Green** (roof, terraces, podiums, grade-level) ***and*** **Energy Efficiency** | **Energy Efficiency** | **Enterprise Green Communities Certification** |
| Green area equivalent to:<br>Coverage required above but not provided<br>$xx/sf of required green area<br>(*fee to be set by rate study) | Green area equivalent to:<br>3% of gross floor area; 18% of total roof area; or available roof space – whichever is least)<br>AND<br>Minimum 5% energy savings<br>above current City of Denver energy code | Minimum 12% energy savings<br>above current City of Denver energy code | Minimum certification |

* All buildings will require a Cool Roof unless the roof is a character defining architectural feature.

Source: City of Denver

**Figure 5**
**Existing Building Compliance Options**




Source: City of Denver

This analysis provides background information and recommendations for the rate per square foot financial contribution for new buildings. The task force's goal for this option is that it be a viable compliance option that achieves the benefits of the original ordinance and that it helps the City provide an "equivalent benefit".

### 2.1. Scope of Work

In order to develop the rate, ArLand reached out to metro area landscaping, engineering and construction firms and requested cost information and site plans for both recent public and private projects. It examined both green roofs and green space scenarios. It analyzed Denver County Assessor's information for land values. ArLand worked closely with staff in the Department of Public Health and Environment, Public Works, Parks and Recreation, and the City Attorney's Office in collecting cost information as well as obtaining any relevant background information. It also worked closely with staff in defining "equivalent benefit" projects.

The scope of work shows the cost the City would incur to install equivalent required green space on the ground as what would have been required to be installed on the building site to comply with the proposed Green Building Policy. The cost for installing green space on the ground includes items such as land value, construction, and operation and maintenance. The cost of land has to be included because the City occasionally purchases land. The fee has to be reasonably connected to the cost for the City to supply the service.

The study also shows the cost for the City to install an equivalent sized green roof as what would have been required to be installed on the building to comply with the proposed Green Building

Policy. The cost for installing a green roof should include items such as construction, and operations and maintenance.

Because the City will be administering these funds, the rate study will determine the necessary administrative costs of the City. The rate study is based on City pricing not private pricing. The rate study also includes a recommendation on how the fee should best be indexed in the future with a formula tying it to an index/value that is measured regularly.

### 2.2 Green Space / Green Roof Standard

Rates are fundamentally based on the costs of green space or green roof projects. There are standards under which the green space or green roof must be supplied, however. Under a green space scenario, the green space must be included in the site plan. The green roof/green space must be above and beyond the storm water quality and detention requirements and above and beyond any green space currently required in zoning setback areas or open space requirements.

The green roof / green space requirements can be met utilizing the following strategies:

- Extensive and Intensive Green Roofs, including roofs-at-grade
- Trees
- Groundcover and shrubs
- Ground level food production
- Financial contribution at the recommended rate included in this report

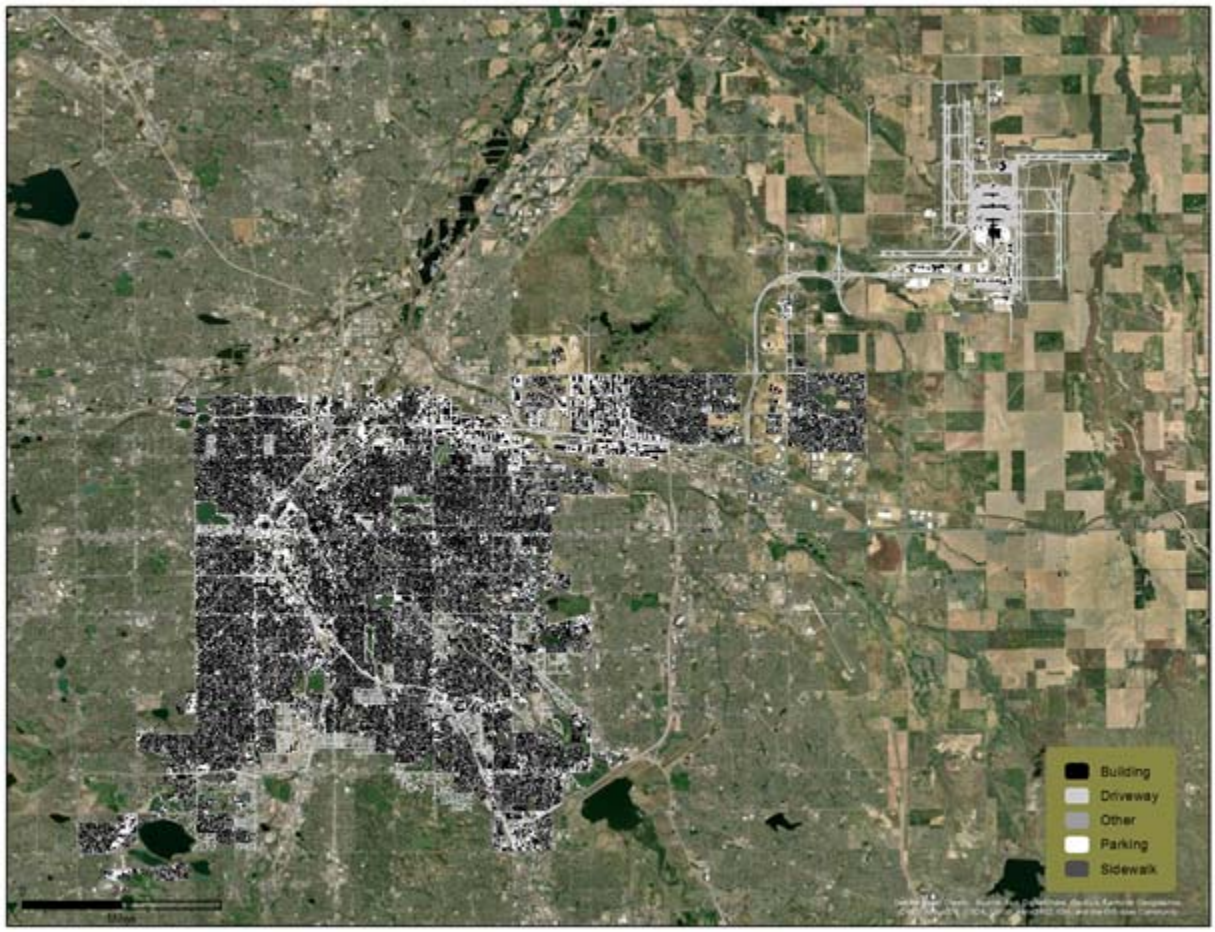
The City's Forester has standards under which the green space must be provided in order to ensure that the green space provided is compatible with City requirements.

### 2.3 Equivalent Benefit Projects

As Denver has continued to grow, develop, and urbanize, more of its land is covered by impervious surfaces which include buildings, parking lots, and driveways, in addition to public infrastructure like sidewalks, streets and highways. Figure 6 highlights areas within Denver with the greatest amount of impervious surface. Not surprisingly, these areas tend to be those with the greatest density of buildings, as well as along major highway corridors.

Figure 6 points to the areas of potentially the greatest green space and green infrastructure needs that correspond to areas where the greatest impact might be seen. Further analysis will be needed to identify appropriate projects. It is likely that most of the potential projects that would provide equivalent benefit would be green space projects, rather than green roofs.

**Figure 6**
**Denver's Impervious Surfaces**




Source: DRCOG, City of Denver

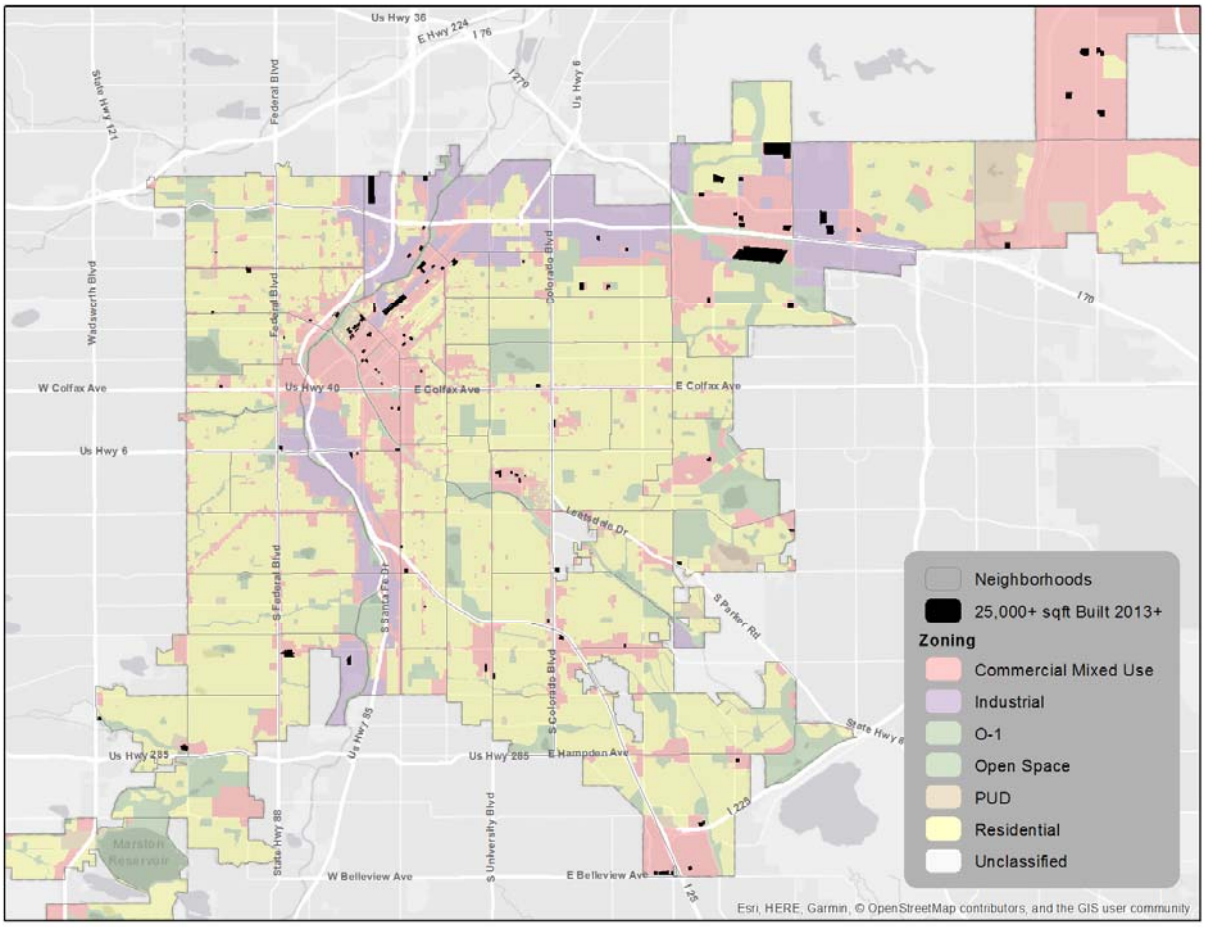
The following report is organized as follows:

- *Past Development Trends:* This section provides background and framework for the analysis focusing on buildings 25,000 square feet and larger built recently in the City
- *Land Values*: In order for the City to provide an equivalent benefit, it should have the option of purchasing land to provide green space. This section shows land values throughout the City.
- *Capital Costs: T*he costs of constructing green space and green roofs are discussed in this section. Construction cost price indices and trends seen in construction materials over time are also discussed.
- *Operations & Maintenance*: Keeping green spaces alive is vital in ensuring that the City achieve the objectives set by the initiative. Operations and maintenance activities are discussed and enumerated.

- *Calculating the City's Equivalent Benefit:* This section describes equivalent benefit type projects. It also discusses additional administrative costs, such as project and program management, the City would incur if it provided equivalent benefit services.
- *Fee Analysis and Recommendations:* This section recommends an appropriate fee range based on the analysis presented. It also suggests an appropriate price index to consult when setting the new rate in the future.

## III. Past Development Trends

**Figure 7**
**Buildings Built >25,000 Square Feet, 2013-2017**




Source: Denver County Assessor's Office, ArLand

Figure 7 shows the locations of buildings larger than 25,000 square feet built from 2013 to 2017 based on Denver County Assessor's records. Although Table 1 on the following page indicates that most were built in Stapleton, near Union Station, Five Points, and Cherry Creek, the figure and table also indicate that buildings 25,000 square feet and larger were built throughout the City during this time.

**Table 1**
**Neighborhoods Where Buildings Built >25,000 Square Feet, 2013-2017**

| Neighborhood | No. of Buildings >25,000 sf: 2013-2017 | Neighborhood | No. of Buildings >25,000 sf: 2013-2017 | Neighborhood | No. of Buildings >25,000 sf: 2013-2017 |
|---|---|---|---|---|---|
| Stapleton | 19 | Baker | 2 | Lowry Field | 1 |
| Union Station | 14 | Bear Valley | 2 | North Capitol Hill | 1 |
| Five Points | 12 | College View - South Platte | 2 | Platt Park | 1 |
| Cherry Creek | 9 | Washington Park West | 2 | Sun Valley | 1 |
| DIA | 5 | Windsor | 2 | University | 1 |
| Globeville | 5 | Berkeley | 1 | University Hills | 1 |
| Highland | 5 | City Park | 1 | University Park | 1 |
| Southmoor Park | 5 | Clayton | 1 | Virginia Village | 1 |
| CBD | 4 | Cole | 1 | West Colfax | 1 |
| Northeast Park Hill | 4 | Cory - Merrill | 1 | | |
| Civic Center | 3 | Gateway - Green Valley Ranch | 1 | | |
| Hampden South | 3 | Hale | 1 | | |
| Montbello | 3 | Jefferson Park | 1 | | |
| West Highland | 3 | Lincoln Park | 1 | | |

Source: Denver County Assessor's Office, ArLand

**Table 2**
**Land Use, Number and Average Sizes of Buildings >25,000 Square Feet, 2013-2017**

| Land Use | Square Footages 2013-2017 | Count 2013-2017 | Average Size Structure |
|---|---|---|---|
| Office | 6,783,220 | 35 | 193,806 |
| Mini-Storage/Warehouse | 5,786,745 | 33 | 175,356 |
| Hotel | 2,916,005 | 24 | 121,500 |
| Residential | 548,135 | 12 | 45,678 |
| Retail/Restaurant | 516,855 | 10 | 51,686 |
| Medical | 464,788 | 4 | 116,197 |
| Other | 283,598 | 4 | 70,900 |
| Parking | 352,600 | 1 | 352,600 |
| **Total** | **17,651,946** | **123** | **143,512** |

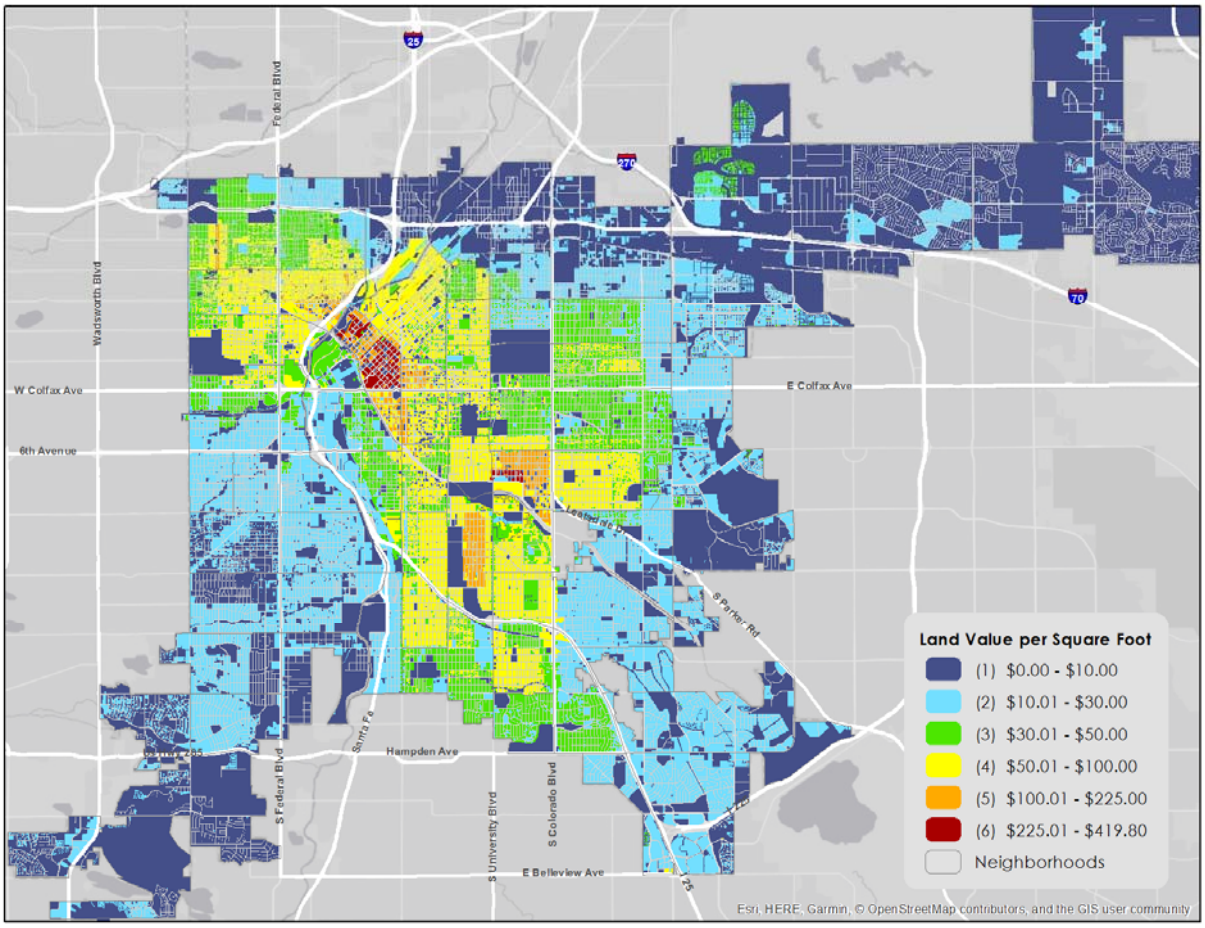
Source: Denver County Assessor's Office, ArLand

Table 2 shows that from 2013 to 2017, the greatest number of buildings 25,000 square feet and larger have been offices, and mini-storage and warehouse (industrial) buildings, followed by hotels, residential buildings, and retail/restaurants.

# IV. LAND VALUES

## 4.1 Land Values Per Square Foot

**Figure 8**
**Land Value per Square Foot throughout the City of Denver**




Source: Denver County Assessor's Office, ArLand

Land costs or value are evaluated and included because the City may purchase land for green space or public improvements. Land values in Denver were divided into six groups based on their price per square foot. The lowest land value group (Group 1) ranges from $0 to $10 per square foot, and the highest land value group (Group 6) ranges from $225 to $420 per square foot. Most of the land in Group 1 is located on the outer edges of the city in the southwest corner, and the northern edge of the city including Green Valley Ranch, industrial land along I-70 and near the airport. This category also includes government owned property including City-owned property such as parks and municipal buildings. Area 2 includes many of the residential neighborhoods south and west of downtown and in southeast Denver including Virginia Village and Hampden. Area 3 includes neighborhoods like City Park and Park Hill and neighborhoods to the south like University Park. Berkeley and Sunnyside are also in Area 3. Area 4 includes neighborhoods like Congress Park, parts of

the Highland, and West Washington Park. Area 5 includes Washington Park, Baker, Belcaro, and Capitol Hill. Area 6 includes the highest value real estate in the City of Denver including Cherry Creek North, Lower Downtown, and the Central Business District neighborhoods.

# V. CAPITAL COSTS

Capital costs include the cost of construction. In this case, we examined both green roofs and green space on the ground. Construction costs and plans were collected from several general contractors, green roofing specialists, developers, and landscape architects practicing in the Denver metro area. We also obtained cost information and plans from appropriate City staff people managing contractor bids for parks and green infrastructure projects for the City.

## 5.1 Green Roofs

A green roof is the roof of a building or structure that is covered partially or completely with vegetation and a growing media (soil) over a waterproof membrane. Additionally, in the Denver climate, these roofs will also include drainage and protection layers and irrigation.

Green roof systems are categorized into two types: Extensive (shallow) and Intensive (deep). They can be modular, rolled, or built-up utilizing loose media and vegetation. Extensive green roofs are typically 4-6" deep and are intended to provide support for range of plant material that is capable of thriving with limited water and maintenance. Intensive green roofs are deeper than 6-8" and can be up to several feet deep to support a wider variety of vegetative types. They require more structural support but can be a building amenity for tenants. Both types of roofs are very effective at attenuating small to medium intensity storm events by detaining water and slowly releasing it over a long period of time.

Green roofs are composed of many elements, the following of which are essential:

- Waterproofing membrane
- Root and protection barrier
- Drainage layer
- Filter fabric
- Growing medium
- Vegetation
- Irrigation

In addition to the above components, green roofs may include other layers like additional insulation, leak detection, foam layers for landform sculpting, erosion control, and water retention. Some components beyond those found in the list above may be required by building or design codes. In drier climates, such as Denver, the root barrier is extra important due to the native plants' hardy roots which can pose a risk to the waterproofing membrane and cause a leak in the green roof system.[1]

[1] Toderlund, 2010. *Design Guidelines and Maintenance Manual for Green Roofs in the Semi-Arid and Arid West.* Leila Tolderlund, University of Colorado, Denver. November 10, 2010.

**Table 3**
**Denver Metro Area Green Roofs**

| DESCRIPTION OF PROJECT | LONE TREE OFFICE (EXTENSIVE) | MORRISON UTILITY (EXTENSIVE) | GENERIC (EXTENSIVE) | DENVER URBAN OFFICE (INTENSIVE) | DOWNTOWN OFFICE [1] (EXTENSIVE) | DOWNTOWN OFFICE [1] (EXTENSIVE) | DENVER SUBURBAN OFFICE [1] (EXTENSIVE) |
|---|---|---|---|---|---|---|---|
| Completion Date | 2014 | 2018-2019 | 2018 | 2017 | 2006 | 2009 | 2007 |
| Type | Private | Public | Private | Private | Public | Public | Private |
| SQFT | 46,807 | 4,500 | 3,300 | 11,000 | 20,000 | 7,500 | 2,100 |
| Design Cost (8-10% of Construction) | $ 83,249 | -- | -- | -- | -- | -- | -- |
| DESIGN $ / SF | $ 2 | -- | -- | -- | -- | -- | -- |
| | | | | | | | |
| LANDSCAPING | | | | | | | |
| Mobilization, General Conditions, Supervision | $ 53,683 | Included | Included | Included | Included | Included | Included |
| Landscaping | $ 731,350 | $ 158,750 | $ 83,480 | $ 385,000 | $ 441,986 | $ 189,355 | $ 55,984 |
| Irrigation | $ 139,956 | Included | Included | Included | Included | Included | Included |
| SUBTOTAL | $ 924,989 | $ 158,750 | $ 83,480 | $ 385,000 | $ 441,986 | $ 189,355 | $ 55,984 |
| | | | | | | | |
| $ / SF OF LANDSCAPING | $ 20 | $ 35 | $ 25 | $ 35 | $ 22 | $ 25 | $ 27 |
| $ / SF of LANDSCAPING & DESIGN | $ 22 | -- | -- | -- | -- | -- | -- |
| | | | | | | | |
| Roof | -- | $ 85,564.00 | Included | Included | Included | Included | Included |
| $ / SF of ROOF | -- | $ 19 | Included | Included | Included | Included | Included |
| | | | | | | | |
| **$ / SF of LANDSCAPING & ROOF** | **--** | **$ 54** | **$ 25** | **$ 35** | **$ 22** | **$ 25** | **$ 27** |

Source: Denver metro contractors, CU Denver, ArLand

[1] 2018 equivalent; costs inflated by 3% annually

Table 3 shows a variety of mostly extensive green roof projects based on current contractor feedback and CU academic research. As the lowest cost option for green roofs is an extensive system with sedum, examples that most closely mirrored that type of roof are shown.

As seen in Table 3, the costs of the selected green roofs range from $22 per square foot to $54 per square foot with most in the $25 per square foot range. The Denver urban office example is for an intensive green roof but a fairly simply planted green roof area (prairie grass). The Morrison Utility green roof is for a relative small project in an area where materials need to be hauled in an area with a significant amount of topography.

Costs includes both the protective roofing as well as the landscaping materials. Conversations with green roofing specialists indicate that economies of scale apply for green roofs. The larger extensive green roofs tend to be less expensive on a per square foot basis because some of the fixed costs can be spread over a larger area.

## Table 4
## Private Green Space Projects

| DESCRIPTION OF PROJECT | DENVER-URBAN | DENVER-DOWNTOWN | DENVER-DOWNTOWN | DENVER-URBAN | DENVER INDUSTRIAL | DENVER-DOWNTOWN | DENVER-NEIGHBORHOOD | DENVER-NEIGHBORHOOD |
|---|---|---|---|---|---|---|---|---|
| Completion Date | 2017 | 2017 | 2018 | 2018 | 2019 | 2014 | 2016 | 2016 |
| SQFT | 304,000 | 300,000 | 1,185,000 | 175,000 | 332,000 | >1 Million | -- | -- |
| Delivery Method | Design-Build | CM/GC | CM/GC | -- | | -- | -- | -- |
| Construction Cost of Work | $ 46,891,570 | $ 43,459,325 | $ 186,659,783 | $50,000,000 | Nearly $200 Million | -- | -- | -- |
| | | | | | | | | |
| LANDSCAPING | | | | | | | | |
| Soil Mitigation Measures | Overexcavation and recompaction of 36" of soil and import of structural fill | Remove contaminated soil and replace with structural fill | Debris removal and import fill | -- | All Site Work | -- | -- | -- |
| Cost of soil mitigation (Included in "Site Preparations" above) | $ 240,000 | $ 568,527 | $ 599,775 | -- | | -- | -- | -- |
| Stormwater or water quality cost (included in "Site Civil / Mechanical Utilities" above) | $ 225,000 | $ 80,000 | $ 180,000 | -- | | -- | -- | -- |
| Site Work | | | | | $ 23,923,153 | | | |
| Landscaping | $ 275,000 | $ 107,570 | $ 645,000 | $320,921 | $ 90,000 | $ 41,193 | $ 214,444 | $ 1,106,417 |
| Total | $ 740,000 | $ 756,097 | $ 1,424,775 | $ 320,921 | $ 24,013,153 | $ 41,193 | $ 214,444 | $ 1,106,417 |
| | | | | | | | | |
| SQFT of landscaping | 3,370 | 2,185 | 5,000 | 26,525 | 528,409 | 825 | 9,403 | 26,845 |
| | | | | | | | | |
| Estimated design cost for landscaping (12%) | $ 33,000 | $ 12,908 | $ 77,400 | $ 38,511 | $ 10,800 | $ 4,943 | $ 25,733 | $ 132,770 |
| **$ / SF OF LANDSCAPING & DESIGN** | **$ 91** | **$ 55** | **$ 144** | **$ 14** | **$ 0** | **$ 56** | **$ 26** | **$ 46** |
| | | | | | | | | |
| **$ / SF OF ALL ELEMENTS** | **$ 229** | **$ 352** | **$ 300** | **$ 14** | **$ 45** | **$ 56** | **$ 26** | **$ 46** |
| | | | | | | | | |
| | Trees shrubs and sod around perimeter of professional building and adjoining surface parking; fairly extensive; includes soil and stormwater | Some trees and shrubs around the periphery of building; but fairly simple; includes soil and stormwater | Includes landscape around building periphery and a roof terracing plan; includes soil and stormwater | Trees and shrubs around building and parking; fairly simple | Campus; LEED Platinum | Redo of landscaping around existing office building | Landscaping around master planned community | Landscaping around master planned community |

Source: Denver metro contractors, ArLand

| DESCRIPTION OF PROJECT | GREELEY DOWNTOWN | GREELEY DOWNTOWN | FORT COLLINS DOWNTOWN |
|---|---|---|---|
| Completion Date | 2018 | 2017 | 2017 |
| SQFT | 48,000 | 124,000 | 118,000 |
| Delivery Method | CM/GC | CM/GC | CM/GC |
| Construction Cost of Work | $ 14,009,843 | $ 26,481,153 | $ 28,989,348 |
| | | | |
| LANDSCAPING | | | |
| Soil Mitigation Measures | Dynamic compaction, imported fill | Dynamic compaction, imported fill | Overexcavation and replacement of 2' of soil |
| Cost of soil mitigation (Included in "Site Preparations" above) | $ 68,616 | $ 77,288 | $ 115,282 |
| Stormwater or water quality cost (included in "Site Civil / Mechanical Utilities" above) | $ 22,315 | $ 38,881 | $ 48,337 |
| | | | |
| Landscaping | $ 208,000 | $ 120,000 | $ 85,700 |
| Total | $ 298,931 | $ 236,169 | $ 249,319 |
| | | | |
| SQFT of landscaping | 22,110 | 6,788 | 9,916 |
| | | | |
| Estimated design cost for landscaping (12%) | $ 24,960 | $ 14,400 | $ 10,284 |
| **$ / SF OF LANDSCAPING & DESIGN** | **$ 11** | **$ 20** | **$ 10** |
| | | | |
| **$ / SF OF ALL ELEMENTS** | **$ 15** | **$ 37** | **$ 26** |
| | | | |
| | Extensive trees shrubs around periphery of office building; also includes rain garden | Trees and shrubs around building and parking; includes gathering space areas | Trees and shrubs around building and parking |

Source: Denver metro contractors, ArLand

## 5.2 Green Space on the Ground (Private)

Table 4 provides data for various private projects that provide green space on the ground, as opposed to a green roof system. The costs per square foot range from $14 to $352 and reflect the location and intensity of the landscaping program. The $14 per square foot figure includes some trees, shrubs, and parking while the $352 per square foot figure includes mature landscaping, soil mitigation and stormwater management elements in a relatively small area which explains the high per square foot cost. Many of the Denver-Downtown and Denver-Urban projects use silva cells in their landscaping programs which can be quite expensive ranging up to $100 per square foot in some cases. [2]

Less intensive landscaping programs in Denver range from $14 per square foot up to $56 per square foot for an average of approximately $35 per square foot.

## 5.3 Green Space on the Ground (Public)

**Table 5**
**Public Green Space Projects**

| DESCRIPTION OF PROJECT | URBAN PARK [1] | REC CENTER GREEN SPACE URBAN NEIGHBORHOOD [1] | WATER QUALITY PLANTERS [1] | SUBURBAN PARKS | BIKE LOOP; GREEN INFRASTRUCTURE [1] | WATER QUALITY AND TRANSPORTATION [2] | CORRIDOR WATER QUALITY STREETSCAPE [1] |
|---|---|---|---|---|---|---|---|
| Completion Date | 2019 | 2018 | 2018 | Ongoing | 2018 | 2019 | 2018 |
| SQFT | 161,172 | 16,940 | 2,132 | 3 Million | 13,000 | 10,000 | 9,600 |
| Design Cost | $ 720,000 | $ 20,039 | $ 9,398 | $1 Million | $ 86,025 | $ 183,000 | $ 116,434 |
| Estimated construction cost of work | $ 4,800,000 | $ 133,594 | $ 62,656 | $15 Million | $ 573,500 | $ 610,000 | $ 776,225 |
| | | | | | | | |
| TOTAL LANDSCAPING AND AMENITIES | $ 5,520,000 | $ 153,633 | $ 72,054 | $15 Million | $ 659,525 | $ 793,000 | $ 892,659 |
| | | | | | | | |
| **$ / SF OF LANDSCAPING** | **$ 30** | **$ 8** | **$ 29** | **$ 5** | **$ 44** | **$ 61** | **$ 81** |
| **$ / SF OF LANDSCAPING & DESIGN** | **$ 34** | **$ 9** | **$ 34** | **$ 5** | **$ 51** | **$ 79** | **$ 93** |
| | | | | | | | |
| | Highly amenitized small urban park with plazas, gathering spaces, festival streets | Green space ROW area in urban rec center | Water quality planters *add on* to existing park plan | Suburban Park buildout | Stormwater and green infrastructure additions to transportation and mobility project | Sidewalk, parking and green space change to transportation project | Water quality planters |

Source: City of Denver, ArLand

Note: Staff time to project manage is not included here; included elsewhere

[1] Design estimated at 15% of construction cost

[2] Design estimated at 30% of construction cost

Table 5 shows costs for various public green space projects that were built recently or scheduled to be completed in the near future. They range in size, scale, and type. The costs range from $5 to $93 per square foot. The $5 per square foot figure is for a large (3 million square feet) suburban park project with a significant amount of natural area which requires little management. Portions of landscaping at a recently built recreation center costs approximately $9 per square foot. In contrast, a small, highly amenitized 160,000 (3 acre) urban park costs approximately $35 per square foot.

Green infrastructure projects tend to be small, but impactful, and in some cases leverage existing infrastructure projects (5280 bicycle loop), and address water quality and drainage. Projects typically

[2] Silva cells are a modular subsurface structural system which accommodates healthy and uncompacted soils enabling landscaping to thrive while accommodating different types of paving materials, traffic loads and utilities. They are designed to enable mature trees to be planted and thrive in urban environments.

range from $50 to $80 per square foot. At the high end, projects can range up to $93 per square foot for an urban corridor that includes streetscape and water quality elements.

### 5.4 Relevant Capital Costs

Our capital cost analysis is incorporating the cost figures for green roofs at $25 per square foot for extensive roofs and $35 per square foot for simple intensive roofs. $200 to $350 per square foot are used to represent projects with mature landscaping, soil and stormwater costs. An average of $35 per square foot for private landscape projects and public urban parks are also relevant to our analysis. Other relevant costs include $50 per square foot up to $80 per square foot for green infrastructure projects.

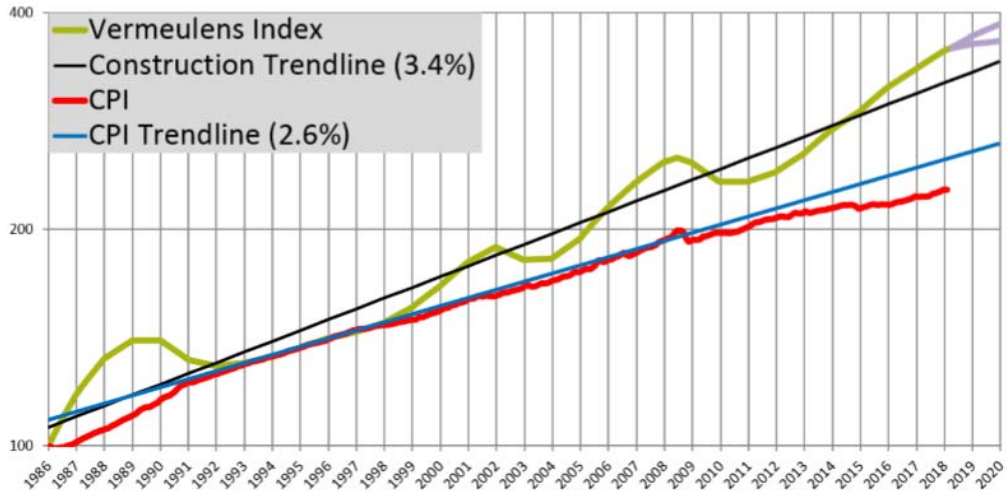
### 5.5 Construction Cost Increases

In order to insure that the in-lieu fee rate provides equivalent benefit, the rate also needs to reflect capital cost increases over time. Green space and roofs includes plants, landscaping materials, and construction materials. Feedback from local contractors indicate that plant costs do not mirror costs of construction materials. However, additional feedback has indicated that due to the amount of time needed to grow mature landscaping and less local availability, some landscapers have gone out of state to obtain plants, resulting in added costs for delivery.

Local contractors have suggested several construction cost indices. The more popular indices include RS Means and ENR which are available at the Denver Public Library in the reference section. Rider Levett Bucknall and Vermeulens also track construction costs. Most of the indices track costs nationally, with a local factor that can be provided to adjust the change in costs to the local market.

Other fees within the City include suggested indices such as the Consumer Price Index in order to adjust fees to the changing price environment. While the CPI is a is a popular index which tracks consumer goods and services, Figure 9 shows that construction costs (Vermeulens Index) have outpaced the CPI, especially in recent years, and therefore may not truly reflect the construction price environment.

**Figure 9**
**Consumer Price Index vs. the Vermeulens Construction Index**




Source: Vermeulens

Mortenson's Denver Office has developed a series of construction cost indices which cover major metropolitan areas, including the Denver metro area. The Mortenson Construction Cost Index is calculated quarterly by pricing a representative non-residential construction project in geographies throughout the country. The index and newsletter is updated quarterly and is available on line at https://www.mortenson.com/cost-index.

This particular index reflects the local construction price situation for commercial buildings.

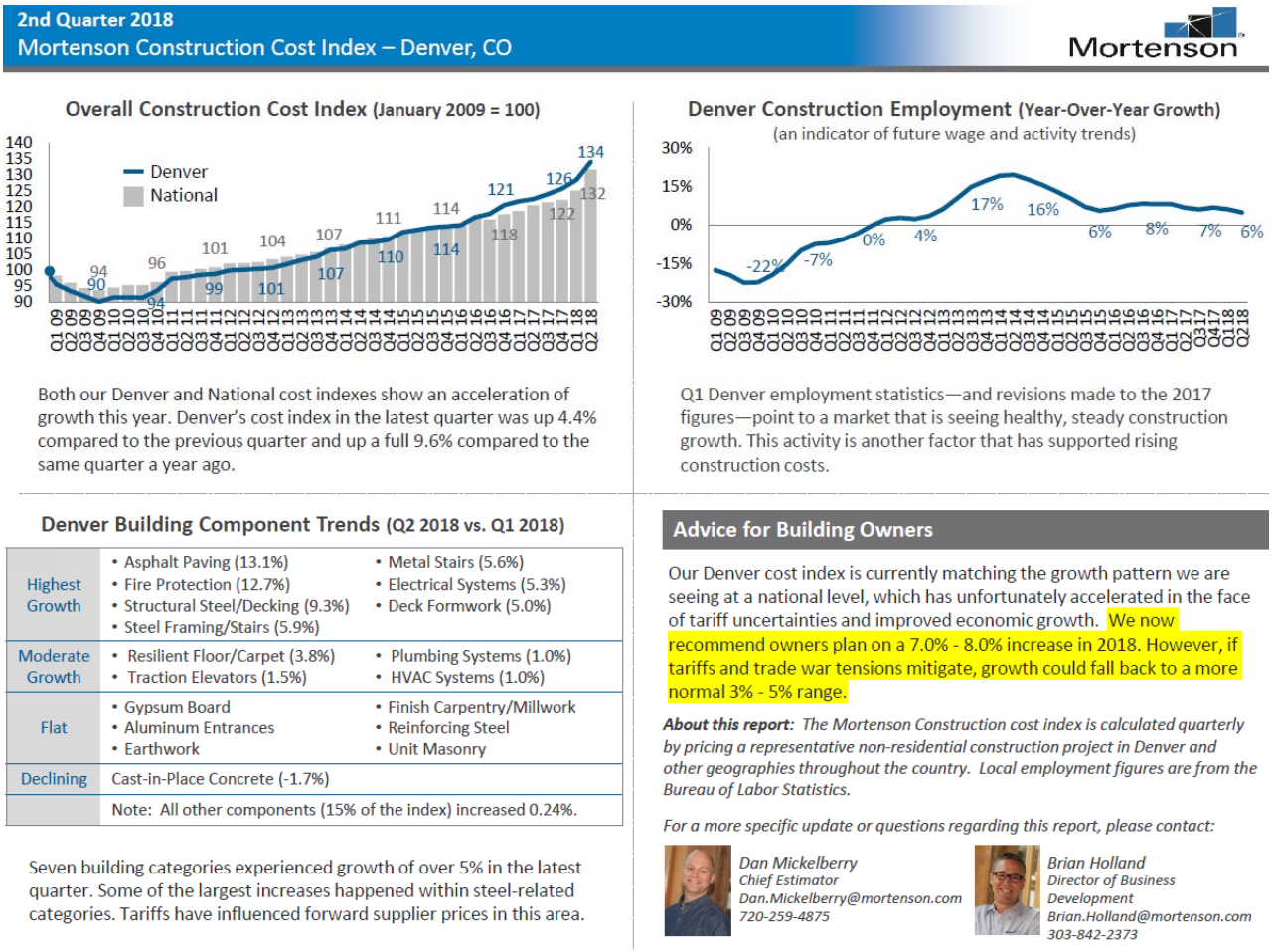
**Table 6**
**Mortenson Denver vs. National Construction Cost Index for a Commercial Building**

| Year | Denver | National |
|---|---|---|
| 2009 | 90 | 94 |
| 2010 | 94 | 96 |
| 2011 | 99 | 101 |
| 2012 | 101 | 104 |
| 2013 | 107 | 107 |
| 2014 | 110 | 111 |
| 2015 | 114 | 114 |
| 2016 | 118 | 121 |
| 2017 | 122 | 126 |
| 2018 | 132 | 134 |
| | | |
| 2009-2018 | 4.3% | 4.0% |
| 2013-2018 | 4.3% | 4.6% |

Source: Mortenson, ArLand

Table 6 shows that construction materials have increased by 4.3% annually in the last 5-10 years. Interviews have indicated that green space materials have increased by 3% to 5% annually in recent years. The escalation factor used in this report has been rounded to 4%.

**Figure 10**
**Local (Mortenson) Construction Cost Index**




Source: Mortenson

# VI. Operations and Maintenance

## 6.1 Green Roof / Green Space Maintenance

**Green Roofs**
Green roofs require maintenance for both the plants themselves as well as the other components. Waterproof membranes must be evaluated to ensure they are not damaged or otherwise compromised. Green roofs provide additional protection to membranes from sun exposure, incidental damage from maintenance crews and hail, which is a significant issue in the Denver region, and are shown to extend the life of membranes by two to three times. Experts suggest multiple inspections of the exposed membrane throughout the year, especially near membrane penetrations like vents, walls, and air conditioning units, among others. The drain elements must also be evaluated a few times per year to ensure that they continue functioning properly and are not blocked or clogged. The plants themselves must be maintained to ensure continued growth and the irrigation system monitored for breaks and winterized each fall. Routine landscaping (weeding, pruning, etc.) must be conducted two to four times per year to ensure the vitality of the green roof system.

**Green Space**
Like green roofs, green space requires maintenance of the plants and any irrigation components that may be a part of the system. As with green roofs, plantings require more attention during the first two years to ensure their survival, irrigation systems must be examined for leaks and other issues, and routine landscaping must also be undertaken throughout the year.

## 6.2 Green Maintenance Costs

Costs for maintaining extensive green roofs and less intensively used green space on the ground can be roughly comparable based on interviews with green space maintenance providers and green roof specialists. After initial plant stabilization, operations and maintenance costs are estimated at $.20 per square foot. Plant stabilization costs, however, can be high at approximately $1 per square foot. This represents the "low" Operations and Maintenance scenario.

Interviews with City Parks and Recreation staff indicate that operations and maintenance costs for the more intensively used downtown urban parks are as high as $.71 per square foot. This cost covers more intensive use, special events, and trash among other higher maintenance items. This represents the "high" Operations and Maintenance scenario.

## 6.3 Net Present Value of Operations and Maintenance

Operations and maintenance costs can vary depending on the type of project so our analysis provides a range of potential costs. For the "low" Operations and Maintenance scenario, we assume that stabilization costs are high as initial years can be tough on plants and materials, and additional watering and work are needed.

Table 7 shows the Net Present Value of 20 years of Operations and Maintenance Costs assuming the first two years are $1 per square foot and $.20 per square foot thereafter. Net Present Value is a way

of measuring the value of future cash flows. It is based on the concept of Time Value of Money where one dollar today is more than one dollar in the future because of its potential earning capacity. Based on past construction trends, our analysis initially assumes that construction costs will continue to escalate by 4% annually in the future on average. In order to reflect the time value of money, our analysis discounts the future cost estimates by 7% annually in order to reflect what the cost is worth today. A 7% discount rate is a commonly used discount rate for federal infrastructure projects. A sum of the discounted costs for this scenario is equivalent to $4.67.

**Table 7**
**Net Present Value of Operations and Maintenance (Low)**

| Year | Operations & Maintenance | 4% Escalated Costs | 7% Discount Factor | Discounted Costs |
|---|---|---|---|---|
| Y1 | $ 1.00 | $ 1.00 | 1 | $ 1.00 |
| Y2 | $ 1.00 | $ 1.04 | 0.935 | $ 0.97 |
| Y3 | $ 0.20 | $ 0.22 | 0.873 | $ 0.19 |
| Y4 | $ 0.20 | $ 0.22 | 0.816 | $ 0.18 |
| Y5 | $ 0.20 | $ 0.23 | 0.763 | $ 0.18 |
| Y6 | $ 0.20 | $ 0.24 | 0.713 | $ 0.17 |
| Y7 | $ 0.20 | $ 0.25 | 0.666 | $ 0.17 |
| Y8 | $ 0.20 | $ 0.26 | 0.623 | $ 0.16 |
| Y9 | $ 0.20 | $ 0.27 | 0.582 | $ 0.16 |
| Y10 | $ 0.20 | $ 0.28 | 0.544 | $ 0.15 |
| Y11 | $ 0.20 | $ 0.30 | 0.508 | $ 0.15 |
| Y12 | $ 0.20 | $ 0.31 | 0.475 | $ 0.15 |
| Y13 | $ 0.20 | $ 0.32 | 0.444 | $ 0.14 |
| Y14 | $ 0.20 | $ 0.33 | 0.415 | $ 0.14 |
| Y15 | $ 0.20 | $ 0.35 | 0.388 | $ 0.13 |
| Y16 | $ 0.20 | $ 0.36 | 0.362 | $ 0.13 |
| Y17 | $ 0.20 | $ 0.37 | 0.339 | $ 0.13 |
| Y18 | $ 0.20 | $ 0.39 | 0.317 | $ 0.12 |
| Y19 | $ 0.20 | $ 0.41 | 0.296 | $ 0.12 |
| Y20 | $ 0.20 | $ 0.42 | 0.277 | $ 0.12 |
| | | | | **$ 4.67** |

Source: ArLand, industry interviews, City of Denver

Table 8 shows the high scenario. Operations and maintenance costs for the more intensively used downtown urban parks are as high as $.71 per square foot. This costs also covers special events and trash removal among other higher maintenance items. The Net Present Value of these costs is about $11.00.

**Table 8**
**Net Present Value of Operations and Maintenance (High)**

| Year | Operations & Maintenance | 4% Escalated Costs | 7% Discount Factor | Discounted Costs |
|---|---|---|---|---|
| Y1 | $ 0.71 | $ 0.71 | 1 | $ 0.71 |
| Y2 | $ 0.71 | $ 0.74 | 0.935 | $ 0.69 |
| Y3 | $ 0.71 | $ 0.77 | 0.873 | $ 0.67 |
| Y4 | $ 0.71 | $ 0.80 | 0.816 | $ 0.65 |
| Y5 | $ 0.71 | $ 0.83 | 0.763 | $ 0.63 |
| Y6 | $ 0.71 | $ 0.86 | 0.713 | $ 0.62 |
| Y7 | $ 0.71 | $ 0.90 | 0.666 | $ 0.60 |
| Y8 | $ 0.71 | $ 0.93 | 0.623 | $ 0.58 |
| Y9 | $ 0.71 | $ 0.97 | 0.582 | $ 0.57 |
| Y10 | $ 0.71 | $ 1.01 | 0.544 | $ 0.55 |
| Y11 | $ 0.71 | $ 1.05 | 0.508 | $ 0.53 |
| Y12 | $ 0.71 | $ 1.09 | 0.475 | $ 0.52 |
| Y13 | $ 0.71 | $ 1.14 | 0.444 | $ 0.50 |
| Y14 | $ 0.71 | $ 1.18 | 0.415 | $ 0.49 |
| Y15 | $ 0.71 | $ 1.23 | 0.388 | $ 0.48 |
| Y16 | $ 0.71 | $ 1.28 | 0.362 | $ 0.46 |
| Y17 | $ 0.71 | $ 1.33 | 0.339 | $ 0.45 |
| Y18 | $ 0.71 | $ 1.38 | 0.317 | $ 0.44 |
| Y19 | $ 0.71 | $ 1.44 | 0.296 | $ 0.43 |
| Y20 | $ 0.71 | $ 1.50 | 0.277 | $ 0.41 |
| | | | | **$ 10.99** |

Source: ArLand, industry interviews, City of Denver

## 6.4 Operations and Maintenance Range

For the purposes of our analysis, Operations and Maintenance values will range from $4.67 on the low end for projects like green roofs and green space up to $11.00 per square foot for intensively managed urban parks.

# VII. CALCULATING THE CITY'S EQUIVALENT BENEFIT

The calculation of equivalent benefit includes a number of components. This section discusses the City's potential equivalent benefit project types as well as additional City costs in managing and implementing these projects. These costs are in addition to land value, capital, operations and maintenance costs previously discussed.

## 7.1 Equivalent Benefit Projects

Green space improvements would have specific requirements which also helps set the parameters of costs for the in-lieu rate. A City committee would help further define what projects should be eligible for that designation. As previously mentioned, the green space needs to be in the approved site plan and be over and above current site plan requirements. The Denver City Forester has requirements in order to ensure that the plantings are appropriate. For example, projects using trees as green space must show on the site development plan how they will be planted with the appropriate supporting infrastructure and / or provide a tree protection plan detailing how trees will be successfully maintained meeting a series of requirements. There are also requirements for groundcover shrubs, xeric grasses, urban agriculture, soil, grading, and irrigation.

Table 9 shows the range of projects that could be defined as "equivalent benefit" and represent those project types the City would likely undertake. They often include projects where a green infrastructure element is added to an existing project in order to assist with area storm drainage or water quality in order to leverage the existing expenditure of funds. They tend to be small, but impactful. They also tend to be interdepartmental and require a great deal of coordination.

They range from $9 to $93 per square foot. The most relevant projects for our analysis includes those at $35 per square foot for urban parks and water quality planters. Per interviews with City Project Managers, green infrastructure projects ranging from $50 to $80 per square foot are also relevant.

**Table 9**
**Sample City Green Projects**

| DESCRIPTION OF PROJECT | URBAN PARK [1] | REC CENTER GREEN SPACE URBAN NEIGHBORHOOD [1] | WATER QUALITY PLANTERS [1] | BIKE LOOP; GREEN INFRASTRUCTURE [1] | WATER QUALITY AND TRANSPORTATION [2] | CORRIDOR WATER QUALITY STREETSCAPE [1] |
|---|---|---|---|---|---|---|
| Completion Date | 2019 | 2018 | 2018 | 2018 | 2019 | 2018 |
| SQFT | 161,172 | 16,940 | 2,132 | 13,000 | 10,000 | 9,600 |
| Design Cost | $ 720,000 | $ 20,039 | $ 9,398 | $ 86,025 | $ 183,000 | $ 116,434 |
| Estimated construction cost of work | $ 4,800,000 | $ 133,594 | $ 62,656 | $ 573,500 | $ 610,000 | $ 776,225 |
| | | | | | | |
| TOTAL LANDSCAPING AND AMENITIES | $ 5,520,000 | $ 153,633 | $ 72,054 | $ 659,525 | $ 793,000 | $ 892,659 |
| | | | | | | |
| **$ / SF OF LANDSCAPING** | **$ 30** | **$ 8** | **$ 29** | **$ 44** | **$ 61** | **$ 81** |
| **$ / SF OF LANDSCAPING & DESIGN** | **$ 34** | **$ 9** | **$ 34** | **$ 51** | **$ 79** | **$ 93** |
| | | | | | | |
| | Highly amenitized small urban park with plazas, gathering spaces, festival streets | Green space ROW area in urban rec center | Water quality planters *add on* to existing park plan | Stormwater and green infrastructure additions to transportation and mobility project | Sidewalk, parking and green space change to transportation project | Water quality planters |

Source: City of Denver, ArLand

Note: Staff time to project manage is not included here; included elsewhere

[1] Design estimated at 15% of construction cost

[2] Design estimated at 30% of construction cost

## 7.2 Project Management

For any project providing equivalent benefit in the form of green space, green roofs or green infrastructure, the City would designate a Project Manager. Interviews with staff indicate that the Project Manager would likely be at a Project Manager II level and total compensation would be nearly $125,000. Assuming a 2 year commitment and 20% of time (per interview), City staff cost for any one project would be $49,814. This cost would be added to the capital costs for a project.

**Table 10**
**City Project Management Costs**

| Department | Position | Classification/Grade | Total Compensation | Time Commitment | City Staff Cost |
|---|---|---|---|---|---|
| Parks or Public Works | Project Manager II | E-816/CE2294 | $ 124,536 | 2 years, 20% of time | $ 49,814 |

Source: City of Denver Budget Office, ArLand

Note: Total compensation includes anticipated DERP (City's retirement), Life, LTD, Medicare, OASDI, Dental and Medical costs.

Table 11 indicates the per square foot cost of project management depending on the project. There is a range. Green infrastructure projects tend to be smaller in scale, but require a tremendous amount of coordination among City departments, engineers, contractors, and others. Although there is no real "average" due to the wide variety of potential projects, 12,000 square feet for a corridor project (corridors are widely represented in the impervious map of Denver) was used to calculate the average staff cost per square foot of $4.15.

Park projects tend to be larger and will often include natural areas and other areas where less management is needed. An approximately 3-acre urban park was used after talking with staff about potential locations for new parks in the City; most of which are likely to be either add-ons to existing parks or in areas which are slated to be fairly urban, in which case the urban parks will likely be smaller and highly amenitized. Staff management costs are estimated at $.31 per square foot.

**Table 11**
**Project Management Costs per Square Foot**

| | |
|---|---|
| 12,000 | SF of Average Size Green Infrastructure Project |
| $ 49,814 | Staff Costs |
| $ 4.15 | Staff Costs / SF of project |
| | |
| 160,000 | SF of Average Size Urban Park Project |
| $ 49,814 | Staff Costs |
| $ 0.31 | Staff Costs/SF of project |

Source: City of Denver, ArLand

## 7.3 Ongoing Project Management

**Table 12**
**Staff Program Management**

| Department | Position | Classification/ Grade | Total Compensation | Hours in a Year | Time Commitment | City Staff Cost |
|---|---|---|---|---|---|---|
| DDPHE | Administrator I | A-810/CA2307 | $94,610 | 2,080 | 1/2 time | $47,305 |
| DDPHE | Administrator II | A-813/CA2308 | $113,358 | 2,080 | 10 hours/year | $545 |
| DDPHE | Administrator II | A-813/CA2309 | $113,358 | 2,080 | 10 hours/year | $545 |
| Finance | Sr. Budget Analyst | V-812/CV2023 | $102,491 | 2,080 | 10 hours/year | $493 |
| Parks | Project Manager I | E-814/CE2291 | $110,229 | 2,080 | 10 hours/year | $530 |
| Parks | Project Manager II | E-816/CE2294 | $124,536 | 2,080 | 10 hours/year | $599 |
| Public Works | Project Manager I | E-814/CE2291 | $110,229 | 2,080 | 10 hours/year | $530 |
| Public Works | Project Manager II | E-816/CE2294 | $124,536 | 2,080 | 10 hours/year | $599 |
| OED | Ec Dev Specialist | A810/CA2171 | $94,610 | 2,080 | 10 hours/year | $455 |
| CPD | Principal City Planner | E-815/CE2159 | $117,144 | 2,080 | 10 hours/year | $563 |
| | | | | | **Total** | **$52,163** |

Source: City of Denver Budget Office, ArLand

Ongoing interdepartmental staff management will be needed among multiple City departments to ensure that multiple departmental perspectives are represented. Table 12 shows staff classifications and grades and estimated time commitment in any one year. It is expected that there will be a staff person in the Department of Public Health and Environment with primary responsibility for the program, while others within the same department, Finance, Parks, Public Works, the Office of Economic Development and Community Planning and Development would have primarily oversight roles. Staff responsibilities would include the selection of equivalent benefit projects and coordination to ensure that implementation moves forward.

**Table 13**
**Ongoing City Program Management**

| | | |
|---|---|---|
| | 17,651,946 | Total sf built for those building >25,000 sf |
| | 3,530,389 | Average sf per year |
| | 26.7% | Percentage of buildings that are exempt |
| | 2,588,952 | Average SF per year built for qualified buildings >25,000 sf |
| | 323,619 | Assume 1 of 8 options or 12.5% of buildings opt in |
| $ | 52,163 | Staff Costs |
| $ | 0.16 | Staff Costs / SF of qualified building |

Source: Denver County Assessor's Office, ArLand

Table 13 estimates the per square foot costs for ongoing staff time. Assuming the past mirrors the future, an average of 3.5 million square feet of buildings were built annually (2013-2017) among those buildings greater than 25,000 square feet (see Table 2). Based on past history, exempt buildings are

deducted leaving 2.6 million square feet of buildings. Assuming that the in-lieu fee option is one of eight options, staff costs are approximately $.16 per square foot of building. The Net Present Value over a 20 year time period of $.16 per square foot (using the same assumptions as before of escalating the costs by 4% per year, and then discounting by a 7% annual factor), yields an equivalent value of $2.48 for ongoing City program management as seen in Table 14. This cost would be added to the Operations and Maintenance category of costs.

**Table 14**
**NPV of Ongoing City Program Management**

| Year | City Admin Costs | 4% Escalated Costs | 7% Discount Factor | Discounted Costs |
|---|---|---|---|---|
| Y1 | $ 0.16 | $ 0.16 | 1 | $ 0.16 |
| Y2 | $ 0.16 | $ 0.17 | 0.935 | $ 0.16 |
| Y3 | $ 0.16 | $ 0.17 | 0.873 | $ 0.15 |
| Y4 | $ 0.16 | $ 0.18 | 0.816 | $ 0.15 |
| Y5 | $ 0.16 | $ 0.19 | 0.763 | $ 0.14 |
| Y6 | $ 0.16 | $ 0.19 | 0.713 | $ 0.14 |
| Y7 | $ 0.16 | $ 0.20 | 0.666 | $ 0.13 |
| Y8 | $ 0.16 | $ 0.21 | 0.623 | $ 0.13 |
| Y9 | $ 0.16 | $ 0.22 | 0.582 | $ 0.13 |
| Y10 | $ 0.16 | $ 0.23 | 0.544 | $ 0.12 |
| Y11 | $ 0.16 | $ 0.24 | 0.508 | $ 0.12 |
| Y12 | $ 0.16 | $ 0.25 | 0.475 | $ 0.12 |
| Y13 | $ 0.16 | $ 0.26 | 0.444 | $ 0.11 |
| Y14 | $ 0.16 | $ 0.27 | 0.415 | $ 0.11 |
| Y15 | $ 0.16 | $ 0.28 | 0.388 | $ 0.11 |
| Y16 | $ 0.16 | $ 0.29 | 0.362 | $ 0.10 |
| Y17 | $ 0.16 | $ 0.30 | 0.339 | $ 0.10 |
| Y18 | $ 0.16 | $ 0.31 | 0.317 | $ 0.10 |
| Y19 | $ 0.16 | $ 0.32 | 0.296 | $ 0.10 |
| Y20 | $ 0.16 | $ 0.34 | 0.277 | $ 0.09 |
| | | | | **$ 2.48** |

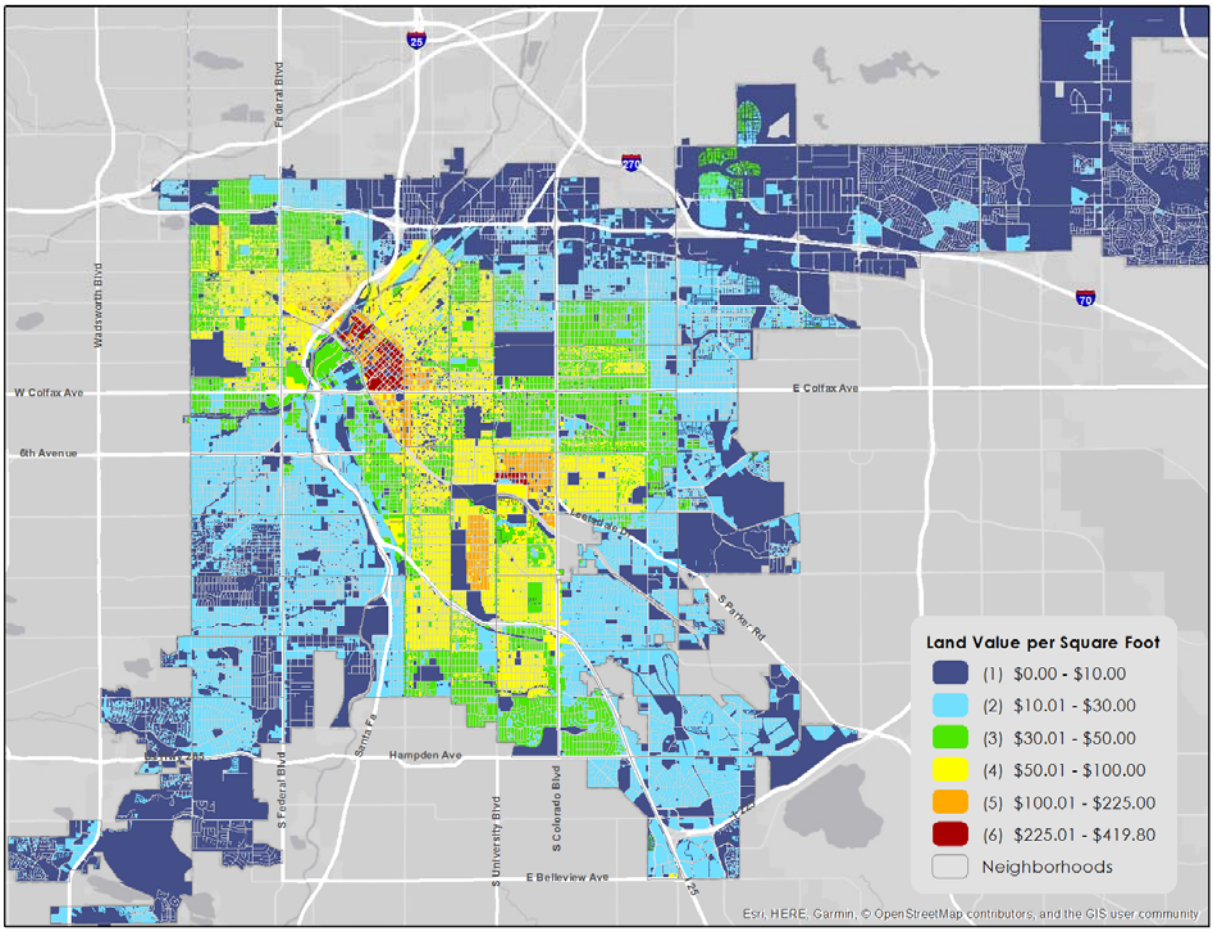
Source: ArLand, industry interviews, City of Denver

## VIII. RECOMMENDATIONS

In order to derive an in-lieu rate range, our analysis incorporates land values, capital costs for equivalent benefit projects, operations and maintenance costs, as well as the City's staff costs associated with administering the program. We developed a range of potential equivalent benefit project options, their costs, and then selected the range from those projects that were more realistic for the City to implement given the current development climate.

### 8.1 Land Values

**Figure 11**
**Denver Land Values**




Source: Denver County Assessor's Office, ArLand

Land values were previously discussed. Given the wide range of land values within the City, selecting one number for the entire City to represent land values was determined to be unrealistic. Based on the breakdowns seen in Figure 11, we selected the midpoint of the range to represent the land values in any one of the geographic areas. It's imperfect as each of the areas potentially represents a range

of uses and value, however, it is helpful in reflecting the cost of land which can be significant in some parts of the City.

**Table 15**
**Land Values by Area**

| **Land Costs** | |
|---|---|
| *Category (average)* | *Select One* |
| City-owned property / ROW | $ - |
| Area 1 | $ 5 |
| Area 2 | $ 20 |
| Area 3 | $ 40 |
| Area 4 | $ 75 |
| Area 5 | $ 163 |
| Area 6 | $ 323 |

Source: Denver County Assessor's Office, ArLand

## 8.2 Project Capital Costs

**Table 16**
**Project Capital Costs**

| **Capital Costs** | |
|---|---|
| *Construction* | *Select One* |
| Suburban park; includes significant natural areas | $ 5 |
| Extensive green roof | $ 25 |
| Landscaping, no hardscape or soil mitigation | $ 25 |
| Urban park / urban green space | $ 35 |
| Intensive green roof (simple) | $ 35 |
| Green infrastructure additions to existing project (low) | $ 50 |
| Green infrastructure additions to existing project (high) | $ 80 |
| Mature landscaping, soil mitigation and hardscape (low) | $ 200 |
| Mature landscaping, soil mitigation and hardscape (high) | $ 350 |
| | |
| *Admin* | *Select One* |
| Park project management | $ 0.30 |
| Green infrastructure project management | $ 4.15 |

Source: Denver County Assessor's Office, ArLand

Table 16 describes the range of capital costs for green space and green infrastructure projects based on the previous analysis. It ranges depending on the type of project from a very large suburban park with significant natural areas at $5 per square foot to green roofs which range from $25 to $35 per square foot for extensive green roofs to simple intensive green roofs, to landscaping. Green infrastructure ranges from $50 $80 per square foot depending on the complexity of the project and coordination needed. Very complex mature landscaping with silva cells and hardscape can range from $200 to $350 per square foot.

Capital administrative costs for City project management, based on the analysis shown in Table 11, are estimated at $.30 per square foot for a park and $4.15 per square foot for green infrastructure management.

### 8.3 Operations and Maintenance

**Table 17**
**Operations and Maintenance**

| **Operations & Maintenance Costs** | | *Always include* |
|---|---|---|
| *Admin* | Interdepartmental staff oversight | $ 2.48 |
| | | *Select One* |
| *O&M* | Basic landscaping (low) | $ 4.67 |
| *O&M* | Intensively used urban park (downtown) (high) | $ 11.00 |

Source: City of Denver, ArLand

Based on Table 14 which represents ongoing staff oversight and costs, the Net Present Value of ongoing staff costs and oversight are estimated at $2.48 per square foot. Interdepartmental staff time in order to coordinate and oversee the program will always be needed and will always be included as part of the in-lieu fee calculation.

Based on Table 7 and Table 8, ongoing operations and maintenance costs for taking care of the improvement on an ongoing basis range from basic landscaping and maintenance estimated at $4.67 per square foot up to $11.00 per square foot for the most intensively used urban park spaces.

### 8.4 Menu of Equivalent Benefits

Table 18 collapses the cost categories into one table to begin to develop the type of equivalent benefit projects, potential geographic locations, and City costs.

- *Land Value:* One value within that box is selected to represent the value of land depending on the location in the City. It assumes that the land would need to be purchased in a private land transaction. Projects on City owned land or in the Right of Way have no land value.
- *Capital Cost*: One value is selected to represent the project type. The most appropriate administrative cost is selected depending on the project type.
- *Operations and Maintenance*: Interdepartmental staff oversight costs are always included. One appropriate Operations and Maintenance number is included.

**Table 18**
**Menu of Equivalent Benefits**

| | | |
|---|---|---|
| **Land Costs** | | |
| *Category (average)* | | *Select One* |
| | City-owned property / ROW | $ - |
| | Area 1 | $ 5 |
| | Area 2 | $ 20 |
| | Area 3 | $ 40 |
| | Area 4 | $ 75 |
| | Area 5 | $ 163 |
| | Area 6 | $ 323 |
| **Capital Costs** | | |
| *Construction* | | *Select One* |
| | Suburban park; includes significant natural areas | $ 5 |
| | Extensive green roof | $ 25 |
| | Landscaping, no hardscape or soil mitigation | $ 25 |
| | Urban park / urban green space | $ 35 |
| | Intensive green roof (simple) | $ 35 |
| | Green infrastructure additions to existing project (low) | $ 50 |
| | Green infrastructure additions to existing project (high) | $ 80 |
| | Mature landscaping, soil mitigation and hardscape (low) | $ 200 |
| | Mature landscaping, soil mitigation and hardscape (high) | $ 350 |
| *Admin* | | *Select One* |
| | Park project management | $ 0.30 |
| | Green infrastructure project management | $ 4.15 |
| **Operations & Maintenance Costs** | | *Always include* |
| *Admin* | Interdepartmental staff oversight | $ 2.48 |
| | | *Select One* |
| *O&M* | Basic landscaping (low) | $ 4.67 |
| *O&M* | Intensively used urban park (downtown) (high) | $ 11.00 |

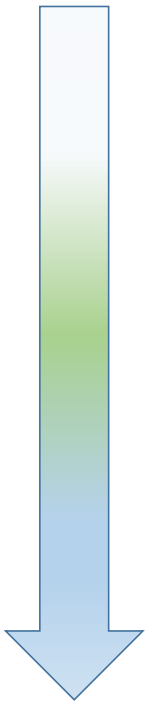
Source: ArLand based on Denver County Assessor's Office, City of Denver, Denver metro area contractors

## 8.5 Recommended Range

Based on a list of potential combinations representing different project types, a range of projects has been compiled and is shown in Table 19. They are based on the sum of the various cost components and have been rounded to the nearest five.

Example projects have been described at various price points. One of the bigger challenges within the City is the availability of land within the City, outside of the airport area. Given activities in the most recent development cycle which saw an unprecedented level of development in Denver, land can be difficult to purchase.

**Table 19**
**Costs of Equivalent Benefit Projects**

| Equivalent Benefit | $ PSF | Example Projects |
|---|---|---|
|  | $ 15 | Suburban park in Area 1 |
| | $ 30 | Extensive green roof on City property ($0 land value) [1] [2] |
| | $ 30 | Landscaping (no soil mitigation / hardscape) on $0 land value property [1] |
| | $ 30 | Suburban park in Area 2; land availability challenge |
| | $ 35 | Landscaping (only) in Area 1 |
| | $ 45 | Intensive green roof on City property ($0 land value) [2] |
| | $ 50 | Urban green space on $0 land value property [1] |
| | $ 60 | Green infrastructure additions (low) on $0 land value property [1] |
| | $ 70 | Urban green space in Area 2 ; land availability challenge |
| | $ 90 | Green infrastructure additions (high) on $0 land value property [1] |
| | $ 90 | Urban green space in Area 3; land availability challenge |
| | $ 100 | Green infrastructure additions (low) in Area 3 |
| | $ 125 | Urban green space in Area 4; land availability challenge |
| | $ 135 | Green infrastructure additions (low) in Area 4 |
| | $ 165 | Green infrastructure additions (high) in Area 4 |
| | $ 210 | Urban green space in Area 5; land availability challenge |
| | $ 220 | Green infrastructure additions (low) in Area 5 |
| | $ 255 | Green infrastructure additions (high) in Area 5 |
| | $ 370 | Urban green space in Area 6; land availability challenge |
| | $ 385 | Green infrastructure additions (low) in Area 6 |
| | $ 535 | Mature landscaping, soil mitigation and hardscape in Area 6 |

Source: ArLand, based on Denver metro area contractors, City of Denver, Denver County Assessor

[1] $0 land value properties include City owned properties and area within City Rights of Way

[2] Does not include costs of retrofitting existing roofs on City buildings to accommodate green roofs

The recommended in-lieu rate range is $50 per square foot up to $90 per square foot representing the most realistic projects the City would undertake.

- At $50 to $90 per square foot, the City could develop a small urban pocket park or plaza in an area where there are no or minimal land value costs, or in Areas 2 and 3 which could accommodate some small neighborhood parks
- Green infrastructure additions can be added on to City Rights of Ways or can be leveraged on to existing transportation mobility or public infrastructure projects

While there are potential projects at $20-$45 per square foot, they are either unrealistic or would be projects that the City would not undertake. For example:

- The City could build a suburban park in Area 1 which includes land near the airport. Given the availability of developers and vast amount of land near the airport, the City would be very unlikely to build a park in that area because a private development company is much more likely to undertake this task as part of its overall development program.
- The City could provide green roofs on City buildings. While not impossible, these costs do not include the cost of testing, retrofitting existing building structural systems in order to support green roofs. Some buildings may be able to support green roofs without additional work, but without additional evaluations of these buildings, it is unknown at this time what the increase in costs would be.
- There is unlikely to be land available in Area 2 to support a suburban park (extensive green space with significant natural areas). Parks in Area 2 would likely be smaller, more urban in nature and highly amenitized and be much more expensive at $70 per square foot.
- Landscaping could be supplied in Area 1 which includes industrial areas. However, landscaping does not include hardscape or soil mitigation which is likely to be needed in these areas. Landscaping in industrial areas may not be the best use of these funds unless combined with drainage and/or water quality projects.

At $100 per square foot and higher, the range of projects, while not impossible becomes more difficult to implement given the availability of land. At the very highest price points, the City would be unlikely to provide projects at this scale which typically feature mature landscaping and extensive hardscape.

### 8.6 Cost Index

Other fees used within the City are subject to annual review and change. The green space in-lieu rate should be subject to the same annual calendar as other fees which are often annual. Prices for equivalent benefit projects are subject to the same conditions as prices for general commercial projects which see constant increases. The Mortenson Construction Cost Index for the Denver metro area is the suggested cost index.