Agricultural Management: Working Lands

- Policy Guidance
  - *City Charter ARTICLE XII. OPEN SPACE*
    - *Section 176 Open Space Purposes – Open space lands*
      - *(d) Preservation of agricultural uses and land suitable for agricultural production*
      - *(b) Preservation of water resources in their natural or traditional state*
  - *Boulder Valley Comprehensive Plan*
    - *9.01 Support for Agriculture*
      - *The city and county will encourage the preservation of working agricultural lands, and sustainable production of agricultural lands as a source of food and feed.*
      - *The city and county will demonstrate and encourage the protection of significant agricultural areas and related water supplies and facilities.*
- Existing Conditions
  - *Summary Statistics:*
    - *Acres in agricultural production (leased lands)*
      - *Irrigable lands leased*
    - *MAP: Leased lands*
  - *Importance and role of lessees in maintaining working lands*
    - *Applying irrigation water, ensuring water is used in order to protect the value of the city's water rights*
    - *Efficiencies of leasing vs. OSMP applying irrigation water and being an agricultural producer*
    - *Source to identify property management infrastructure needs and repairs*
- Objective(s)
  - *Maintain and support working agricultural lands, including the preservation of water resources by leasing land for agricultural uses.*
- Management Strategies
  - *Restore historic irrigation and agricultural uses on selected sites.*
    - *Process:*
      - *Identify irrigable lands currently not irrigated and where historic irrigation infrastructure is present.*
      - *Evaluate the potential of the site for an agricultural use*
        - *Criteria:*
          - *Connectivity/proximity to existing working lands*
          - *Soil quality/characteristics*
          - *Compatibility with existing ecosystem services*
          - *Compatibility with neighboring land uses*

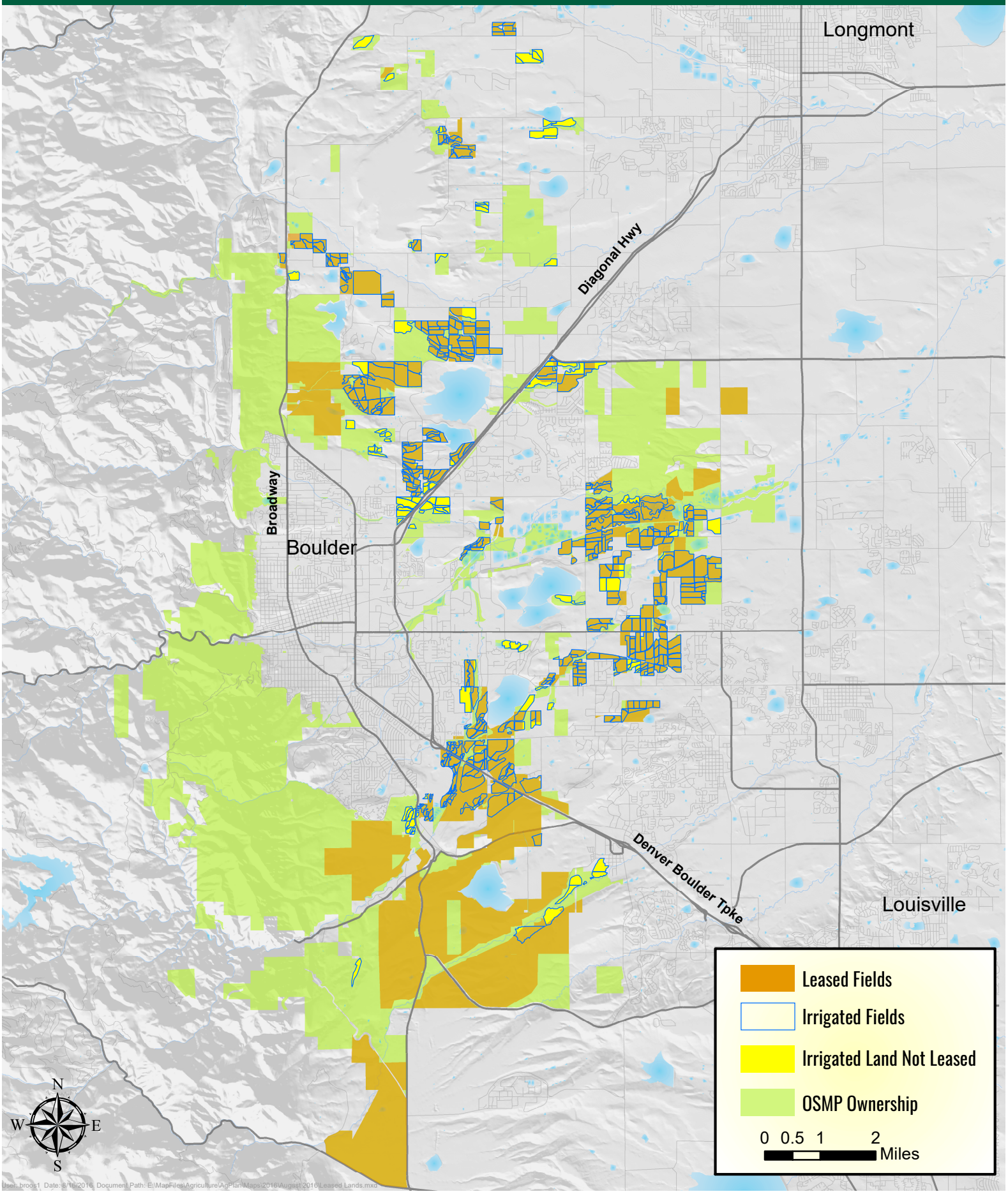
- Measures of Success
    - *Acres in agricultural production (number of acres leased).*
    - *Percent of irrigable land leased for agricultural purposes.*
- Estimated Cost(s)

Cost Equivalents	$ Less than $10,000	$$ $10,000 - $49,999	$$$ $50,000 - $99,999	$$$$ $100,000 - $500,000	$$$$$ More than $500,000

    - *$$*
        - *$10,000 - $49,999 per site for infrastructure improvements and deferred maintenance to restore historic irrigation and agricultural uses on selected sites.*

Agricultural Resources Management Plan

Leased Lands



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Agricultural Management: Leasing Agricultural Lands

- Policy Guidance
  - *Boulder Revised Code*
    - *2-2-8. Conveyance of City Real Property Interests*
      - *(a) The city manager may convey, grant or lease any interest in any city real property for a term of three years or more only if the manager first obtains City Council approval in the form of a motion, after which the manager may sign the deed or other instrument making the conveyance, grant or lease.*
  - *City Charter ARTICLE XII. OPEN SPACE*
    - *Section 171 Function of the department*
      - *Shall acquire, supervise, administer, preserve, and maintain all open space land and other property associated therewith and may grant nonexclusive licenses and permits and agricultural leases for crop or grazing purposes for a term of five years or less.*
    - *Section 177 Disposal of open space land*
      - *No open space land owned by the city may be sold, leased, traded, or otherwise conveyed, nor may any exclusive license or permit on such open space land be given, until approval of such disposal by the City Council. Such approval may be given only after approval of such disposal by the affirmative vote of at least three members of the Open Space Board of Trustees after a public hearing held with notice published at least 10 days in advance in a newspaper of general circulation in the city, giving the location of the land in question and the intended disposal thereof. No open space land owned by the city shall be disposed of until 60 days following the date of City Council approval of such disposal. If, within such 60-day period, a petition meeting the requirements of Section 45 above and signed by registered electors of the city to the number of at least five percent of the registered electors of the city as of the day the petition is filed with the city clerk, requesting that such disposal be submitted to a vote of the electors, such disposal shall not become effective until the steps indicated in Section 46 and Section 47 above have been followed.*
      - *This section shall not apply to agricultural leases for crop or grazing purposes for a term of five years or less.*
- Existing Conditions
  - *Existing Lease Process:*
    - *Properties put up for bid*
    - *Competitive bid process*
    - *Lease rate is determined by the bid of the most qualified applicant*
    - *1-3 year lease established*
      - *Lease Renewal Process:*

        - *Lease expires*
        - *Lessee expresses interest in renewing*
        - *OSMP staff determines lessee is in "good standing"*
        - *Lease renewed at or near established lease rate*
    - *Land / lease tenure – Many of OSMP lessees have been farming/ranching the same lands for decades, some for over 30 years.*
    - *Access and permitted uses within leased area – Agricultural lessees are provided more access and permitted uses than visitors in their leased areas and ditches serving their leased areas to support their agricultural operations, such as:*
        - *Off-trail access in HCAs without an off-trail permit*
        - *Access to closed properties*
        - *Commercial sales (such as direct market hay sales without a commercial use permit)*
        - *Off-leash working dogs in no dog or otherwise leashed areas*
        - *Off-road ATV/vehicle/equipment use*
    - *Current OSMP lease rates comparison to peer agencies and regional rates (both public and private)*
        - *Current lease rates are significantly lower than current market values/peer agency rates. Other operators in the Boulder Valley pay significantly more for similar land.*
        - *There is also an equity issue among OSMP lessees, with newer lessees paying significantly more for similar land than some long-time lessees.*
    - *Liability issues related to agricultural leases*
- Objective(s)
    - *Maintain an agricultural lease program, including lease process and fee structure, compatible with agricultural and resource stewardship and a working lands program.*
    - *Ensure management responsibilities, agricultural stewardship expectations, and permissible uses are clearly defined between OSMP and lessees.*
- Management Strategies
    - *Implement the following lease process:*
        - *Advertise new properties available for lease to the agricultural community at OSMP established rates based on the range of the intensity of permissible agricultural uses.*
        - *Request for proposals*
        - *Lease property to the most qualified applicant*
        - *Establish 1-3 year lease and develop a Property (or lease) Management Plan*
            - *Lease Renewal Process:*
                - *Lease expires*
                - *Lessee expresses interest in renewing*
                - *OSMP staff determines lessee was in compliance with the Property (or lease) Management Plan*
                - *Lease renewed at current OSMP established rates*
    - *Develop a fee structure compatible with agricultural and resource stewardship and a working lands program taking into consideration:*

            - *Lessee impacts / preferences*
            - *Management flexibility*
            - *Multiple objective nature of OSMP agricultural lands (i.e. restrictions and/or conditions placed on lessee operation to achieve other management goals)*
            - *Administration costs / departmental documentation needs*
    - *Develop an incremental / phased approach to implementing an updated fee structure.*
        - *This approach will provide the lessees with larger increases in rates the most time to adjust.*
        - *For example:*
            - *30% increase – 1 year*
            - *30-60% increase – 2 years*
            - *60-90% increase – 3 years*
            - *90-120% increase – 4 years*
            - *120+% increase – 5 years*
    - *Develop Property (or lease) Management Plans to address:*
        - *Compatible resource goals – Ecological*
        - *Agricultural stewardship expectations*
        - *Access and permitted uses*
            - *Off-trail access in HCAs without an off-trail permit*
            - *Access to closed properties*
            - *Commercial sales (such as direct market hay sales without a commercial use permit)*
            - *Off-leash working dogs in no dog or otherwise leashed areas*
            - *Off-road ATV/vehicle/equipment use*
        - *Lessee financial and maintenance responsibilities*
        - *IPM*
        - *Insurance requirements*
        - *Documentation*
        - *OSMP Responsibilities*
            - *Infrastructure improvements*
            - *Maintenance*
            - *Water assessments*
- Measures of Success
    - *Proportion of leases signed and renewed at updated OSMP established lease rates.*
    - *Proportion of leases that have a Property (or lease) Management Plan.*
    - *Proportion of leases in compliance with Property (or lease) Management Plan.*
- Next Steps
    - *Establish lease fees*
        - *Lessee outreach*
- Estimated Cost(s)
    - *No additional costs identified at this time.*

Agricultural Management: Diversity of Agricultural Operations

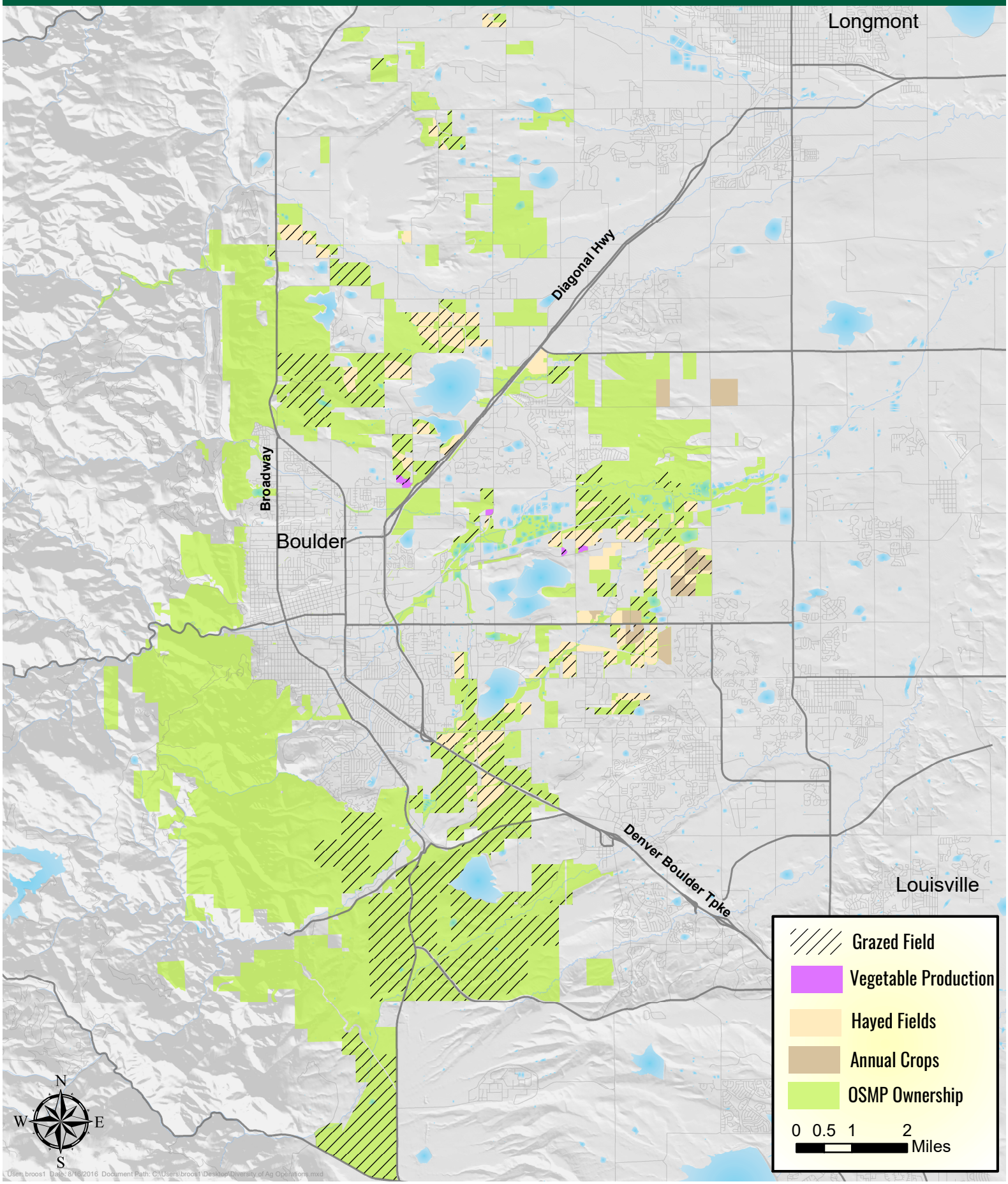
- Policy Guidance
  - *City Council identified the promotion of local foods as a city priority at the 2014 Council Retreat*
  - *Open Space Board of Trustees approval of the departmental practice of prohibiting the use of transgenic crops on open space (2000).*
  - *City Charter ARTICLE XII. OPEN SPACE*
    - *Section 176 Open Space Purposes – Open space lands*
      - *(d) Preservation of agricultural uses and land suitable for agricultural production*
- Existing Conditions
  - *For the past 40 years, OSMP has focused exclusively upon agricultural production of food, feed, and fiber and those activities necessary to support the operations.*
  - *Description of types of Agricultural Operations currently found on OSMP*
    - *Hay production (grass, alfalfa)*
    - *Vegetable farming*
    - *Annual crops (wheat, corn, barley, etc.)*
    - *Livestock production*
    - *Bees*
    - *Fruit orchards*
  - *MAP: Diversity of Agricultural Operations*
  - *Environmental conditions such as soil quality and water availability limit most of the agricultural production on OSMP lands to livestock grazing or hay/forage production.*
  - *OSMP staff has rarely influenced the production choices of agricultural producers other than prohibiting the use of genetically modified organisms (GMOs).*
    - *Lessees have freedom to decide what to grow and to a large degree how to grow it.*
    - *Lessees' choices of specific agricultural commodities are influenced by local markets and their ability to sell a product profitably.*
  - *Requests have been submitted for additional uses related to agriculture such as farm stands and farm dinners or events. Requests have been denied based upon OMSP practice to limit permitted agricultural uses to production. However:*
    - *These other agriculturally related uses can provide opportunities for agricultural producers to diversify their income and market their products.*
    - *Providing farmers and/or ranchers with these opportunities may increase resiliency and/or success rates for local food producers.*
    - *These types of agriculturally related enterprises have also been increasing in popularity nationwide increasing their relevance for OSMP lands.*
- Objective(s)
  - *Maintain and support a diversity of agricultural operations and uses on OSMP lands, with the exception of genetically modified organisms (GMOs).*

    - *Increase the availability of acres for diversified vegetable farming and micro-dairies as market forces allow/demand.*
- Management Strategies
    - *Evaluate the compatibility of other agriculturally related activities on OSMP lands*
        - *The criteria and process will be developed as part of the Community Connections write-up.*
    - *Identify Best Opportunity Areas (BOAs) for diversified vegetable farms and micro-dairies*
        - *Criteria for identifying BOAs:*
            - *Phase I Evaluation Criteria: Essential Characteristics*
                - *Infrastructure – presence of/ proximity to farmstead residence and agricultural outbuildings*
                - *Soil Type – Capability Class I-III on 16 contiguous acres*
                - *Water Availability – 1.5 acre-feet of water per acre for 100 consecutive days*
            - *Phase II Evaluation Criteria:*
                - *Compatibility with VMP Management Area Designations and goals*
                - *Limited conflict with Visitor Infrastructure*
                - *Compatibility with Prairie Dog Colony Management Designation and occupation history*
                - *Compatibility with Bobolink Habitat/Management Area Designations*
                - *Compatibility with other sensitive species habitat conservation objectives*
                    - *Northern leopard frog*
                    - *Nesting raptors*
                    - *Rare and state tracked plan populations and communities*
                    - *Federally threatened or endangered species including Preble's meadow jumping mouse and Ute ladies' tresses (Spiranthes) orchid.*
                - *Presence and Extent of Noxious Weeds*
                - *Compatibility with the conservation of cultural resources and protection of scenic areas*
    - *MAP: Best Opportunity Areas for diversified vegetable farming and/or micro-dairies*
    - *Best Opportunity Areas Summary:*
        - *Nine sites, comprised of 11 properties*
        - *Five sites with infrastructure*
        - *Four sites without infrastructure and can solely be used for expanding a nearby existing operation*
        - *Only a portion of the land identified in each BOA is suitable. The maximum range of acres converted to vegetable farming (every BOA converted) would likely range from approximately 80-250 acres, with only half tilled or in production at a given time.*

- Measures of Success
    - *Types of agricultural operations and agriculturally related uses on OSMP lands.*
        - *Associated acres dedicated to the various types of agricultural operations.*
    - *Acres in diversified vegetable production.*
- Next Steps
    - *1-10 years*
        - *Site selection among the BOAs for conversion to diversified vegetable farming (as market forces allow, 0-2 per year).*
        - *Infrastructure improvements to selected farm site (ongoing as market forces allow, 0-2 per year).*
- Estimated Cost(s)
    - *$$ - $$$$$ for infrastructure improvements to selected farm sites.*
        - *Preliminary estimates for sites with a residence and outbuildings range from $150,000 – more than $500,000 per site.*
        - *Preliminary estimates for "expansion" sites for existing farming operations range from $25,000 - $40,000 per site.*

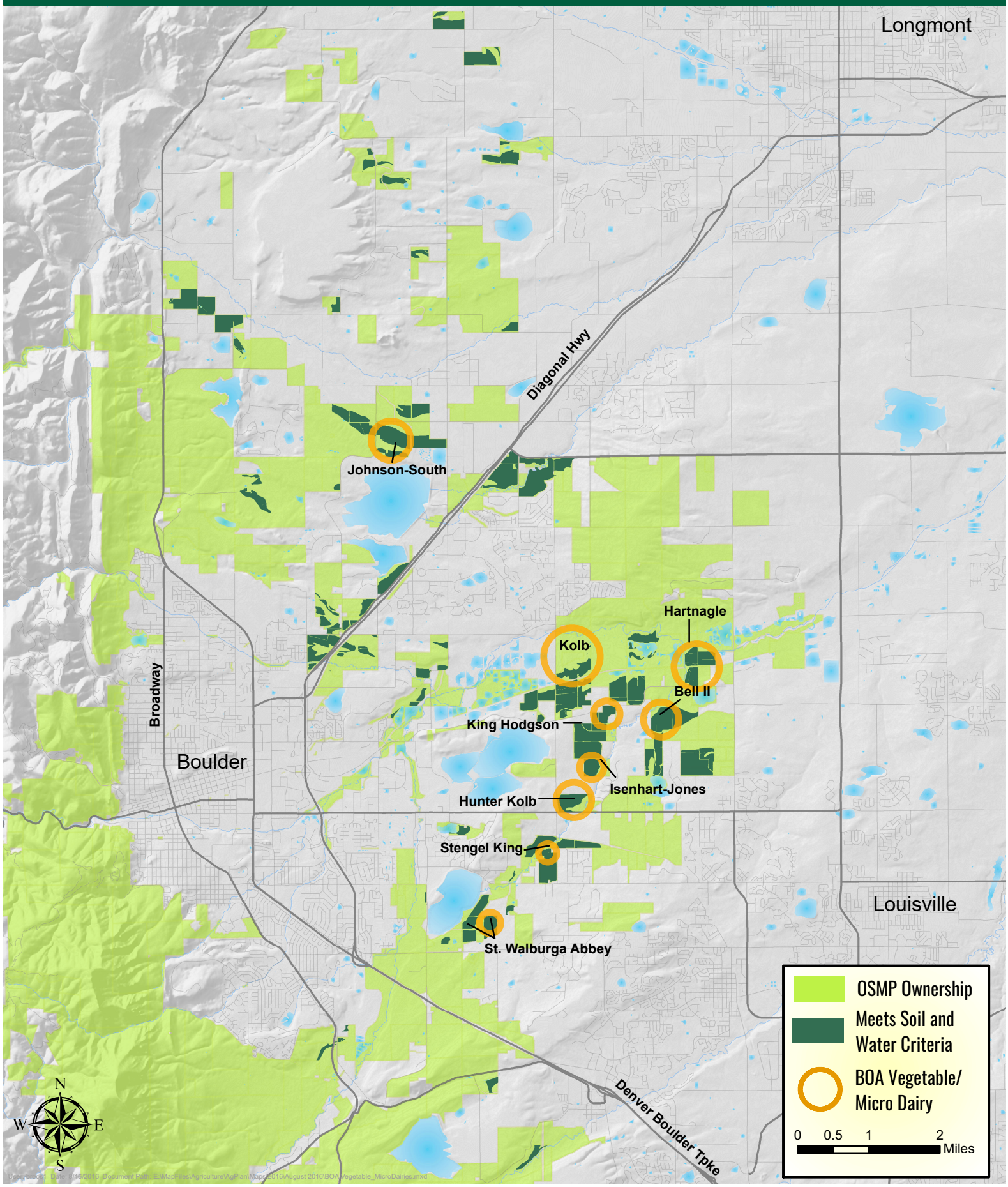
Agricultural Resources Management Plan

Diversity of Agricultural Operations



Agricultural Resources Management Plan

Vegetable Farm/Micro Dairy Best Opportunity Areas



Agricultural Management: Connecting Farmers to Local Markets

- Policy Guidance
  - *Boulder Valley Comprehensive Plan*
    - *9.02 Local Food Production*
      - *The city and county will encourage and support local food production to improve the availability and accessibility of healthy foods and to provide other educational, economic and social benefits. The city and county support increased growth, sales, distribution and consumption of foods that are healthy, sustainably produced and locally grown for all Boulder Valley residents with an emphasis on affordable access to food for everyone and long term availability of food.*
- Existing Conditions
  - *Very limited existing opportunities for direct sales on OSMP properties:*
    - *Hay*
    - *Livestock (live)*
  - *Other opportunities for direct sales off of OSMP properties are limited to:*
    - *Farmers' markets*
    - *Restaurants*
    - *Institutions (such as Boulder Valley School District)*
    - *Wholesale*
    - *Off-site farm stands*
    - *CSAs*
    - *Off-site farm dinners*
  - *Desire for farmers to capture more direct sales.*
- Objective(s)
  - *Provide or improve resources to connect lessees to local markets.*
  - *Support and create opportunities for direct sales on-site and off-site.*
- Management Strategies
  - *Explore the feasibility of addressing missing links to connect lessees to local markets.*
    - *E.g. meat marketing co-op*
  - *Explore synergies between agricultural producers to meet local demand or develop new products*
    - *Bulking production or selling directly to other agricultural producers*
    - *Support for USDA grower/producer grants for innovative production ideas*
  - *Evaluate the compatibility of other on-site agriculturally related activities on OSMP lands.*
    - *The criteria and process will be developed as part of the Community Connections write-up.*
- Measures of Success
  - *Proportion of direct sales.*
  - *Percent of operators engaged in on-site direct sales.*

- Estimated Cost(s)
    - *$$ - $$$$*
        - *$10,000 - $500,000 depending on the permissible on-site agriculturally related activities and whether OSMP provides permanent infrastructure (e.g. parking, building retrofits, new builds)*

Agricultural Management: Connecting Farmers to Resources

- Policy Guidance
  - *None existing specific to this plan component*
- Existing Conditions
  - *Existing Resources*
    - *OSMP currently provides water and land to support agricultural operations.*
    - *OSMP currently provides limited technical support to lessees.*
  - *Additional Resources in the Region*
    - *Boulder County Extension*
      - *Beginner farmer training*
    - *Colorado State University*
      - *Research*
      - *Agribusiness management*
    - *Natural Resource Conservation Service (NRCS) (federal)*
      - *Grants*
      - *Cost sharing*
    - *Boulder and Longmont Soil and Water Conservation Districts (state)*
      - *Water quality and quantity*
      - *Cost sharing*
      - *Noxious weeds*
  - *Barriers and Missing Opportunities*
    - *Availability of water and land to support agricultural operations in the Boulder Valley*
    - *Capital/lack of equity*
    - *Lack of available and consistent labor*
    - *Lack of affordable housing for farm workers*
    - *Lease length (not adequate for farmers to apply for NRCS grants)*
- Objective(s)
  - *Provide or improve information and resources to support local and aspiring operators.*
- Management Strategies
  - *Examine the feasibility of providing additional resources such as:*
    - *Farmer apprentice program*
    - *Succession plans*
    - *OSMP demonstration farm*
    - *Equipment sharing*
    - *Technical advice*
    - *Farm worker/lessee housing*
    - *Partnerships with other agencies (CSU Ext. or BCPOS)*
    - *Producer surveys and outreach*

- Measures of Success
    - *Resources available to support local and aspiring operators.*
- Estimated Cost(s)
    - *$$$-$$$$$*
        - *$50,000 – more than $500,000 dependent on feasibility study and staffing*

Agricultural Management: Infrastructure – Structures

- Policy Guidance
  - *City Charter ARTICLE XII. OPEN SPACE*
    - *Sec. 176 Open Space Purposes – Open space lands*
      - *Open space land may not be improved after acquisition unless such improvements are necessary to protect or maintain the land or to provide for passive recreational, open agricultural, or wildlife habitat use of the land. (Added by Ord. No. 4996 (1986), 1, adopted by electorate on Nov. 4, 1986.)*
  - *Open Space Long Range Management Policies*
    - *Facilities can be constructed on OSMP land if necessary to support approved activities as specified in an Open Space management plan (and in accordance with the Charter Section 176).*
    - *Structures should be consistent with Open Space purposes, be compatible with natural processes, functional, energy efficient and cost-effective.*
    - *Existing buildings will be considered before new construction is contemplated.*
    - *All facility costs including initial construction, refurbishment, or restoration, ongoing maintenance and operational costs should be considered.*
    - *Facilities will be integrated into the Open Space environment so as to result in minimum impact.*
    - *Facilities will be designed and developed to avoid competing with or dominating Open Space features.*
- Existing Conditions
  - *Types of Agricultural Structures commonly found on OSMP*
  - *General condition description – many in poor condition*
  - *Reference to ongoing system-wide structures assessment*
    - *Summary statistics from structures assessment if available at time of writing Draft Plan.*
  - *Desire to maintain and support a diversity of agricultural operations and increase the acres for diversified vegetable farming will likely result in requests and/or needs for additional structures and/or significant repairs.*
- Objective(s)
  - *Provide the infrastructure necessary to support a diversity of agricultural operations.*
  - *Maintain agriculturally related structures in an acceptable condition.*
- Management Strategies
  - *Evaluate new or replacement structures with the following process/criteria:*
    - *Primary test= Charter Test – OSMP determination the proposed structure is "necessary for open agriculture"*
    - *If the primary test is passed, conduct secondary Alternatives Analysis – OSMP determination there are no cost effective and energy efficient alternatives to the proposed structure*

        - *If secondary test is passed, conduct Site Analysis – OSMP review of aesthetic impacts, proximity to building sites, costs, and other existing structures*
        - *Land use review – Permitting process with the land use agency with jurisdiction*
    - *Include a case study/evaluation of Greenhouses and Hoophouses*
    - *Develop criteria to prioritize current and future infrastructure needs*
- Measures of Success
    - *Proportion of operations for which the necessary infrastructure has been identified.*
    - *Proportion of operations for which the necessary infrastructure is currently available.*
    - *Proportion of necessary structures in an acceptable condition.*
- Estimated Cost(s)
    - *$$$$$*
        - *More than $500,000 for structure improvements, construction, de-construction*

Agricultural Management: Infrastructure - Water Delivery

- Policy Guidance
  - *Colorado Revised Statutes (irrigation ditch maintenance)*
    - *Maintenance to prevent flooding*
    - *Maintenance of bridge crossings*
  - *Open Space Long Range Management Policies*
    - *The Department will maintain the integrity of all water delivery and storage structures on its property and cooperate with the office of the State Engineer to the greatest extent possible to meet applicable requirements.*
    - *Alternative funding sources, including participation by other water users, ditch companies, and others, may be required where legally or financially appropriate and feasible.*
    - *The Open Space staff will work with ditch companies that have written easements and prescriptive uses on open space land to encourage maintenance practices that minimize damage to other resources.*
    - *Incorporate practices to maximize irrigation efficiency*
  - *OSMP Grassland Ecosystem Management Plan*
    - *Construct, repair, enhance and maintain irrigation delivery system*
- Existing Conditions
  - *Description of OSMP water portfolio*
  - *Description of existing infrastructure*
    - *A significant amount of maintenance on the water delivery system has been deferred.*
    - *Summary of most recent infrastructure needs assessment*
      - *Functional*
      - *Functional, in need of repair*
        - *Immediate needs*
      - *Non-functional, in need of repair*
        - *immediate needs*
  - *Natural resource value of irrigation infrastructure*
  - *Maintenance of existing infrastructure*
    - *Process*
    - *Costs*
- Objective(s)
  - *Maintain existing irrigation infrastructure in good condition as required by the Colorado Revised Statutes.*
  - *Provide the infrastructure necessary to meet the needs of a diversity of agricultural operations.*
  - *Ensure the water delivery system infrastructure and associated maintenance is compatible with natural resource objectives.*

- Management Strategies
    - *Maintain a regularly updated inventory of irrigation infrastructure that includes location and conditions information (tracking database).*
    - *Partner with lessees to provide and maintain infrastructure necessary to meet the needs of their agricultural operations.*
    - *Develop and implement irrigation infrastructure Best Management Practices for water delivery infrastructure maintenance and construction.*
    - *Develop criteria to prioritize current and future infrastructure needs.*
    - *Evaluate water management opportunities and resource enhancement potential.*
        - *Environmental Water Sharing Feasibility study in progress*
- Measures of Success
    - *Percent of irrigation infrastructure in good condition as defined by the Colorado Revised Statutes.*
    - *Proportion of operations for which the necessary irrigation infrastructure is currently available.*
    - *Proportion of irrigation infrastructure maintenance sites in compliance with departmental Best Management Practices.*
- Estimated Cost(s)
    - *$$$$$*
        - *More than $500,000 to address back log of irrigation infrastructure improvements.*
        - *Preliminary estimates based on currently identified infrastructure needs are approximately $650,000.*

Agricultural Management: Soil Conditions

- Policy Guidance
  - *Open Space Long Range Management Policies*
    - *Minimize soil loss and blowing dust by appropriate agricultural and soil management practices.*
    - *Impacts on soil resources will be monitored, as feasible. Management actions may be taken to mitigate adverse, potentially irreversible, impacts on soils caused by compaction, contamination, and erosion. Conservation practices will be implemented to reduce these impacts. Soil degradation will be minimized. If soil is imported, actions will be taken to avoid introduction of exotic species.*
    - *The department will preserve the soil resources of Open Space lands and prevent, to the extent possible, the erosion, physical removal, or contamination of the soil, or its contamination of other resources. Detailed soil maps defining the distribution of soil series will be used to provide interpretations needed to promote soil conservation and to guide management decisions by Open Space staff.*
  - *Grassland Ecosystem Management Plan*
    - *Manage agricultural activities to minimize soil erosion and protect soil fertility.*
- Existing Conditions
  - *Importance of soil health (include sidebar on soil health)*
  - *Acres currently tilled annually*
  - *Acres previously tilled now turned back into grasslands, perennial hay*
  - *General condition description – no regular monitoring by OSMP*
  - *Description of effect of prairie dogs on soil conditions*
- Objective(s)
  - *Increase soil organic matter and soil biological diversity on all OSMP lands, with focus on tilled lands*
- Management Strategies
  - *Manage agricultural activities to minimize soil erosion and protect soil fertility.*
    - *Best Management Practices (from NRCS)*
      - *Conservation tillage*
      - *Cover cropping*
      - *Diverse crop rotations*
      - *Stubble height*
      - *Compost and organic matter amendments*
    - *Set minimum standards for number of years a field can be continuously tilled*
  - *Develop soil health monitoring plan to track soil organic matter and soil health over time.*
    - *Develop soil sampling protocols and monitoring schedule for:*
      - *Irrigated annually tilled fields*
      - *Dry land annually tilled fields*
      - *Irrigated hayfields and pasture*
- Measures of Success
  - *Change in soil health/organic matter over time*

    - *Proportion of operations implementing appropriate soil protecting measures*
- Research Opportunities
    - *Best ways to decrease tillage – in organic and non -Round Up Ready systems*
    - *Living covers for annually tilled fields*
    - *Viable intercropping systems*
    - *Viable cover cropping systems*
    - *Carbon sequestration potential of integrated livestock-crop operations*
    - *Investigation of different rapid soil respiration assessments*
- Estimated Cost(s)
    - *$-$$*
        - *Less than $10,000 for annual soil sampling + tests, cover crop seed, compost*
        - *$10,000 - $49,999 for additional staff to collect samples*

Agricultural Management: Integrated Pest Management (on non-native landscapes)

- Policy Guidance
  - *City of Boulder IPM Policy*
    - *Requires a hierarchical approach to pest management, beginning with prevention. Chemical controls are assumed to be potentially harmful to human and environmental health and should be the very last step after other methods have been found ineffective or unfeasible. Regardless of whether non-chemical or chemical controls are used to manage pests, pests should be mapped and monitored and a threshold established before treatment is considered. The IPM Policy requires that the following strategies be used in order, with prevention being the most effective and preferred strategy.*
      i. Prevention
      ii. Cultural
      iii. Mechanical
      iv. Biological
      v. Chemical
- Existing Conditions
  - *The following can detrimentally effect crop yield and agricultural productivity:*
    - *Weeds*
    - *Fungal pathogens*
    - *Bacterial pathogens*
    - *Viruses*
    - *Insects*
  - *Lessees are responsible for IPM on their leased property.*
    - *Organic operators typically focus on prevention, cultural, and mechanical techniques with Organic Materials Review Institute (OMRI) approved chemicals as a last resort.*
    - *Conventional operators vary in their approach depending on the crop.*
      - *Conventional grass hay is typically not sprayed.*
      - *Conventional alfalfa is typically treated once a year for alfalfa weevil.*
      - *Commodity annual crops vary, but can be treated for weeds, insects and fungal pathogens. Applications may range from annual to as needed based on economic threshold (cost of application versus crop quality and quantity loss).*
  - *OSMP has encouraged non-chemical pest management, when possible, and least persistent and least toxic pesticide, when chemical treatment is determined necessary.*
  - *Existing OSMP review and approval/denial process for chemical treatments:*
    - *Lessee is required to provide the following information upon their request:*
      - *Chemical name*

            - *Application rate*
            - *Target pest*
            - *Acres*
        - *Staff often conducts a site visit to verify pest presence*
        - *Staff evaluates the proposed treatment taking into account the following:*
            - *Consistency with City IPM Policy*
            - *Concentration and rate applied*
            - *Application method*
            - *Amount used*
            - *Cumulative risk to non-target organisms, human health and the environment.*
        - *Staff approves/denies proposed chemical treatment*
        - *Staff posts notification of chemical application on pesticide hotline and on the property*
        - *Staff tracks the amount of pesticide product used at each site by target pest.*
    - *Current pesticide usage on OSMP agricultural properties*
        - *Acres, as a percentage of total agricultural acreage*
- Objective(s)
    - *Reduce state-listed noxious weeds on agricultural properties*
    - *Reduce or eliminate pesticides, wherever possible*
        - *When reduction or elimination of pesticides is not possible, use the least toxic, least persistent pesticide*
- Management Strategies
    - *Encourage lessees to explore Best Management Practices focusing on preventative, cultural and mechanical methods that are best suited to their particular property, such as:*
        - *Integrating livestock*
        - *Using bubblers to remove weed seeds from irrigation water*
        - *Planting non-crop barriers and strips to provide habitat for wildlife and natural enemies, prevent soil and water erosion and buffer the use of any pesticides off-site.*
        - *Incorporating conservation tillage practices*
        - *Planting cover crops to enhance soil fertility and assist with natural pest controls.*
        - *Rotating crops and diversifying fields with intercropping.*
        - *Growing crops suited to the local environment.*
    - *Promote adoption of these Best Management Practices by exploring cost-sharing, lease reductions, and collaboration with NRCS.*
    - *Prioritize management of state-listed noxious and invasive species, especially in crop buffer areas.*
        - *Planning and implementation to be done in partnership with lessees via Property (or lease) Management Plans*
    - *OSMP review and approval/denial process for chemical treatments:*
        - *Lessee request for application*
            - *Chemical name*

        - *Application rate*
        - *Target pest*
        - *Acres*
    - *Mandatory site visit and staff verification of pest presence*
    - *Verify economic threshold loss potential has been reached (if applicable)*
    - *Staff evaluates the proposed treatment taking into account the following:*
        - *Consistency with City IPM Policy*
        - *Concentration and rate applied*
        - *Application method*
        - *Amount used*
        - *Cumulative risk to non-target organisms, human health and the environment.*
        - *IPM Prime – method for evaluating toxicity*
    - *Staff approval/denial of proposed chemical treatment*
    - *Staff determination of appropriate buffers by taking into account:*
        - *Drift potential*
        - *Proximity to neighbors, schools*
        - *If the location presents risks to aquatic life and/or wildlife*
    - *Staff posts notification of chemical use on pesticide hotline and on property.*
    - *Staff tracks the amount of pesticide product used at each site by target pest.*
- Measures of Success
    - *Decrease in volume and acreage of pesticide applications (pesticide usage will never be eliminated without eliminating certain crops)*
    - *Decrease in volume of most toxic pesticide applications*
    - *Proportion of operations in compliance with established Property (or lease) Management Plans (addresses IPM)*
    - *Decrease in state-listed noxious and invasive weeds on agricultural properties.*
- Research Opportunities
    - *Alternatives for Warrior II for alfalfa weevil management*
    - *Rx grazing for weed management on non-native grasslands*
    - *Non-chemical control options in commodity crops*
- Estimated Cost(s)
    - *$-$$*
        - *Less than $10,000 - $49,999 for possible program for cost-sharing of reduced risk chemicals and additional staffing for mandatory scouting*

Agricultural Management: Climate Change Preparedness

- Policy Guidance
  - *Boulder Resiliency Plan (draft, 2016)*
  - *Colorado Climate Change Vulnerability Study (2015)*
  - *Boulder County Climate Change Preparedness Plan (2012)*
  - *Boulder's Climate Commitment (draft, 2016)*
  - *Boulder Valley Comprehensive Plan*
  - *Boulder Climate Workshop (in progress, 2016)*
  - *Colorado Water Plan*
- Existing Conditions
  - *Past*
    - *CO_2 increasing*
    - *Temperatures rising*
    - *Recent large disturbance events that climate change may contribute to*
      - *2002 drought*
      - *2010 4-mile canyon fire*
      - *2013 front range floods*
  - *Future*
    - *High confidence*
      - *More CO_2*
      - *2-6 F warming by 2050*
      - *More heat waves*
      - *Earlier snow melt*
    - *Medium confidence*
      - *More drought*
      - *More heavy precipitation*
      - *More wildfire*
      - *Bigger snow storms*
    - *Unknown/Low confidence*
      - *Annual precipitation*
      - *Tornadoes and hail storms*
  - *Potential effects to Agricultural Productivity and Management*
    - *Rising atmospheric CO_2*
      - *Decreasing time b/w germination and plant maturity, reducing yields*
      - *C3 crops (small grain cereals) show positive yield response to increase atmospheric CO_2 – but protein dilution*
      - *Forage crops will have higher C: N ratios*
      - *Some weeds are especially responsive to CO_2*
        - *Herbicide efficacy decreases with increased atmospheric CO_2*

    - *High CO_2 reduces nutritional quality*
- *Increased temperatures*
    - *Hot temperatures late in the growing season may reduce (or require cooling with irrigation)*
    - *High temperatures negatively affect flowering, grain set and yield*
    - *High temperatures stress plants and activation of heat shock proteins can change shifts in composition of proteins in cereal grains—affecting baking quality*
    - *Warm temperatures in winter can affect winter hardiness of perennial forage species*
    - *Expanding growing season length may increase susceptibility to frosts*
    - *Precipitation is coming as rain instead of snow – implications for water rights - timing and quantity of available water*
- *Pest and disease outbreaks:*
    - *Increases to pest survival due to warm overnight temperatures and more susceptible plants, due to drought stress; could lead to more chemical use*
    - *Shifts in ranges of insects, leading to increased populations of marginally-overwintering species*
    - *Greater ranges of pests not currently present in Colorado*
    - *Additional generations by traditionally univoltine insects*
- *Changing weather patterns*
    - *Extreme events (heat, cold, precipitation, hail) can physically damage crops and wash away soil, seeds, or plants*
    - *Higher volume rain events*
        - *Delayed plantings or harvest*
        - *Increased susceptibility to root diseases*
        - *Increased soil compaction*
- *General uncertainty how increases in temperature, variable weather, increased CO_2 will all combine together to affect agriculture (which one will be the main driver)*
- *Change in location and scale of agricultural operations*
- *Increased crop water use with decreases in water availability and storage*
- *Irrigated hay fields -> pasture or native grasslands*
- *Conflict between water for irrigated agriculture and aquatic and riparian habitats.*
- *Grazing*
    - *Increase length of forage production season, but may reduce forage quality (high CO_2 reduces nutritional quality)*
    - *"Lengthening growing seasons; however, could reduce the need to accumulate winter forage."*
    - *Water and drought both affect forage*
    - *C3 and C4 grasses*
- *Interacting drivers*

        - *Population growth*
        - *Energy availability*
        - *Economic vitality*
        - *Shifting demographics*
        - *Land use*
- Objective(s)
    - *Prepare for climate change by identifying agricultural management practices in response to increased aridity.*
    - *Research the potential for agricultural practices to mitigate climate change.*
- Management Strategies/Criteria/ Processes/ Examples (if applicable)
    - *Develop a Water Strategy*
        - *Increase efficiency of water distribution, but be aware that flood irrigation is an important part of groundwater recharge and the support of wetland habitats on OSMP. Establish criteria, working with lessee input, on ditch lining*
            - *Earthen ditch -> lined ditch*
            - *Surface flood -> sprinkler*
        - *Increase water storage*
        - *Water use by plants (crops and varieties)*
        - *Get more water for irrigation*
        - *Prioritize water to fields that need it the most*
        - *Water banking and storm water retention*
    - *Grazing*
        - *De-stocking: protocol, and irrigated hayfield -> pasture (see Grazing the Native Grasslands)*
        - *Prescriptive Grazing / Grazing as an ecological management tool that has sensitivities to climate/drought variability (see Grazing in Native Grasslands)*
        - *Incorporate climate into the Rangeland Condition Assessments*
    - *Farmers*
        - *Increase the flexibility of agricultural management techniques*
            - *Rotation, water use*
        - *Survey of farmer's views on climate change impacts and strategies they might adopt*

- Measures of Success
    - *Climate Change Preparedness strategies "in place" /ready to be implemented.*
        - *Water strategy*
        - *De-stocking protocol*
        - *Rangeland Condition Assessment protocol and monitoring*
    - *Research conducted/ findings.*

- Research Opportunities
    - *Mitigating GHG emissions with agriculture: Soil carbon sequestration; Soil respiration*

- *New types of agriculture*
- *New crop varieties and species*
- *New dryland and low-water commodity crops and forage species*
- *Crop diversity and crop system resilience*
- *Experimental drought / stress tests*
- *Water sharing*