



City of Missoula
Missoula Parks and Recreation

Missoula Parks and Recreation Design Manual 2018 Edition



for
Public Right-of-Ways, Greenways
and Other Public Recreation Facilities

Prepared by
City of Missoula
Missoula Parks and Recreation

Approved by the Missoula Park Board
October 10, 2017

Adopted by the Missoula City Council
December 18, 2017
Resolution No.: 8232

ACKNOWLEDGMENTS

The Missoula Parks and Recreation Design Manual (MPRDM), also known as the City of Missoula Public Landscape and Recreation Facilities Design Manual (MPLRFDM), is an evolving document. The Missoula Parks and Recreation would like to thank all the individuals, organizations and City staff who have contributed to its success.

CITY OF MISSOULA PARKS AND RECREATION

Donna Gaukler, Parks and Recreation Director

Missoula Parks and Recreation Planning, Recreation and Operations Staff

AGENCY, ORGANIZATIONS AND PARTNERS REVIEWS

Missoula Development Services Department

Missoula Redevelopment Agency

Local Engineering, Landscape Architecture, Architecture Firms and Professionals

Local Landscape, Nurseries, and related Professionals

City Parks and Recreation Board

Missoula City Council

TABLE OF CONTENTS

<u>PART</u>	<u>TITLE</u>	<u>PAGE</u>
	INDEX	i, ii, iii
	PREFACE	1
PART 1	GENERAL REQUIREMENTS	
	SECTION 1 DEFINITIONS	4
	SECTION 2 SUBMITTAL REQUIREMENTS AND PROCEDURES	6
	CONSTRUCTION, PLANTING AND IRRIGATION DOCUMENTS.....	6
	CONCEPTUAL PROJECT REVIEW	7
	PROJECT REVIEW	7
	REVIEW FLOW CHART.....	9
	MAINTENANCE DOCUMENTS	10
	PROJECT SPECIAL CONDITIONS	10
	PERMITS.....	11
	PARKLAND RESTRICTION	11
	BIDDING.....	11
	PROJECT INSPECTION	12
	COMPLETION FLOWCHART	13
PART 2	GREENWAYS AND HORTICULTURE DESIGN SPECIFICS	
	INTRODUCTION.....	14
	PREFERENCE FOR NATIVE AND POLINATOR PLANTS	14
	NATIVE PLANTS AND MISSOULA’S EFFORTS TO BECOME A NATIONAL WILDLIFE FEDERATION CERTIFIED “COMMUNITY HABITAT”	15
	BEST MANAGEMENT PRACTICES TO IMPROVE POLLINATOR HABITAT IN CITY LANDSCAPING	15
	SECTION 1 LANDSCAPE DESIGN	16
	MAINTENANCE LEVELS OF SERVICE	16
	LANDSCAPE DESIGN CRITERIA	22
	MAINTENANCE ACCESS AT MEDIAN ISLANDS	24
	SELECTION AND LOCATION OF STREET TREES	24
	MINIMUM WIDTHS OF PLANTING AREAS	25
	MINIMUM SOIL VOLUME	26
	ROOT BARRIERS	27
	WEED BARRIERS	27
	SIGHT VISIBILITY	27
	COMMUNITY POLICING THROUGH ENVIRONMENTAL DESIGN (CPTED)	27
	SECTION 2 IRRIGATION DESIGN	29
	DESIGN CRITERIA	29
	SELECTION OF IRRIGATION EQUIPMENT	29

PART 3

CPTED Principles – Crime Prevention Through Environmental Design

SECTION 1 INTRODUCTION 32
SECTION 2 FOUR CPTED PRINCIPLES..... 32
SECTION 3 DESIGN SPECIFICS..... 32
GOOD DESIGN32
BAD DESIGN.....33

PART 4

ASPHALT PAVEMENT DESIGN GUIDE

SECTION 1 SOIL SUPPORT & CLASSIFICATION 34
A.1 SOIL CLASSIFICATION 35
A.2 AASHTO SOIL CLASSIFICATION TABLES 35
A.3 SUBGRADE STRENGTH..... 35
A.4 SOIL CLASSIFICATION CORRELATION 36
B.1 SOIL TESTING 37
C.1 SEASONAL VARIATIONS..... 37
D.1 SUBGRADE CLASSES 37

SECTION 2 GEOTEXTILES 38

SECTION 3 DRAINAGE..... 38
A.1 GENERAL CONSIDERATIONS..... 38
A.2 SURFACE DRAINAGE..... 39
B.1 SUBSURFACE DRAINAGE..... 40
B.2 SUBDRAINS 40
B.3 FIELD INSPECTION DURING CONSTRUCTION 40

SECTION 4 PAVEMENT THICKNESS DESIGN FOR PARKING LOTS..... 41
A.1 DESIGN PROCEDURE 41
A.2 DESIGN STEPS..... 41
A.3 DESIGN EXAMPLE..... 41
B.1 PAVEMENT THICKNESS TABLES FOR PARKING LOTS..... 42
B.2 HEAVILY LOADED AREAS 42

SECTION 5 CONSTRUCTION PRACTICES – PARKING LOTS 43
A.1 SUBGRADE PREPARATION 43
B.1 ASPHALT LIFT THICKNESS..... 44
C.1 BASE-PLATFORM CONSTRUCTION..... 44
D.1 SURFACE COURSE CONSTRUCTION 44
E.1 JOINTS 45
F.1 TACK COAT 45

SECTION 6 PAVEMENT DESIGN FOR NON-MOTORIZED TRAILS & PATHS ...	45
A.1 GENERAL CONSIDERATIONS.....	45
B.1 DRAINAGE.....	45
C.1 SUBGRADE PREPARATION.....	46
C.2 ROOT INTRUSION INHIBITORS.....	46
C.3 TREE ROOT BARRIERS.....	47
C.4 SOIL STERILANTS.....	47
D.1 ASPHALT CONCRETE PAVEMENTS – TRAILS.....	47
D.2 THICKNESS TABLE - TRAILS, PATHS AND WALKWAYS.....	48
E.1 ASPHALT SEAL COAT.....	48
SECTION 7 CONSTRUCTION PRACTICES - TRAILS & PATHS	48
A.1 SUBGRADE PREPARATION	48
A.2 AGGREGATE BASE COURSE.....	49
B.1 ASPHALT MIX DESIGN	50
B.2 ACCEPTABLE RECLAIMED ASPHALT PAVEMENT PERCENTAGE.....	51
C.1 ASPHALT LIFT THICKNESS.....	51
D.1 SURFACE COURSE CONSTRUCTION	52
E.1 JOINTS.....	52
F.1 TACK COAT	52
SECTION 8 INSPECTION	52
SECTION 9 MPWSS SUPPLEMENTARY SPECIFICATIONS & CONDITIONS ...	54
PART 5	
PARK FACILITY DESIGN CRITERIA	
SECTION 1 INTRODUCTION	56
SECTION 2 NATURAL GRAVEL TRAILS	56
NON-STABILIZED TRAILS.....	56
STABILIZED TRAILS	57
SECTION 3 PARK AND TRAIL LIGHTING DESIGN STANDARDS	58
DESIGN CONSIDERATIONS.....	59
MATERIALS	59
SECTION 4 IMPORTED TOPSOIL REQUIREMENTS	61
SOIL PARAMETERS	62
SOIL TEXTURE TRIANGLE	63
SECTION 5 TURF DESIGN STANDARDS	64
DESIGN CONSIDERATIONS.....	64
APPLICATION.....	65
SECTION 6 SIGNAGE AND BOLLARDS	66
WAYFINDING BOLLARDS.....	66
SECTION 7 GRAFFITI PROTECTION	67

APPENDICES

APPENDIX "A" SAMPLE MAINTENANCE PERFORMANCE SPECIFICATION 68
APPENDIX "B" MAINTENANCE COST IMPACT STATEMENT 70
APPENDIX "C" PLAN SHEET NOTES 71
APPENDIX "D" MPWSS SUPPLEMENTARY AND PROJECT SPECIAL CONDITIONS 84
APPENDIX "E" LANDSCAPE PLANT LIST 93
APPENDIX "F" TREE STOCK QUALITY REQUIREMENTS 109
APPENDIX "G" ACCEPTABLE EQUIPMENT AND MATERIALS EQUALS 114
APPENDIX "H" KNOWN LAND AND WATER CONSERVATION FUND SITES AND
KNOWN DEED RESTRICTED SITES..... 116
APPENDIX "I" STANDARD DETAILS 117
APPENDIX "J" REFERENCED DOCUMENTS 119
APPENDIX "K" APPLICABILITY CLARIFICATION 120

ADOPTING RESOLUTION 121

Author’s Note: Appendices may be reviewed and updated on a yearly basis to ensure the inclusion of most accurate information. It is the responsibility of the Landscape Architect to ensure the most current appendix is being referenced. (Appendix "K" added on 4/17/2020.)

MISSOULA PARKS AND RECREATION DESIGN MANUAL

PREFACE

Missoula Parks and Recreation Design Manual

This design manual provides the procedures for Landscape Architects and others, in the preparation of construction documents for public facilities including, but not limited to, median islands, back-up landscaping, parks, natural areas and other public facilities, where the Missoula Parks and Recreation will assume operations and maintenance activities, or where maintenance and operation of public landscape facilities will be provided by others, such as a homeowners association or a real estate management agency, under a maintenance agreement with the City of Missoula. These requirements will be used as a minimum standard during the City of Missoula review process prior to approval of the construction documents.

The design requirements in this design manual bring together policies from numerous City policy statements and management plans that serve as the foundation of this manual. Figure 1 identifies the source of these policies.

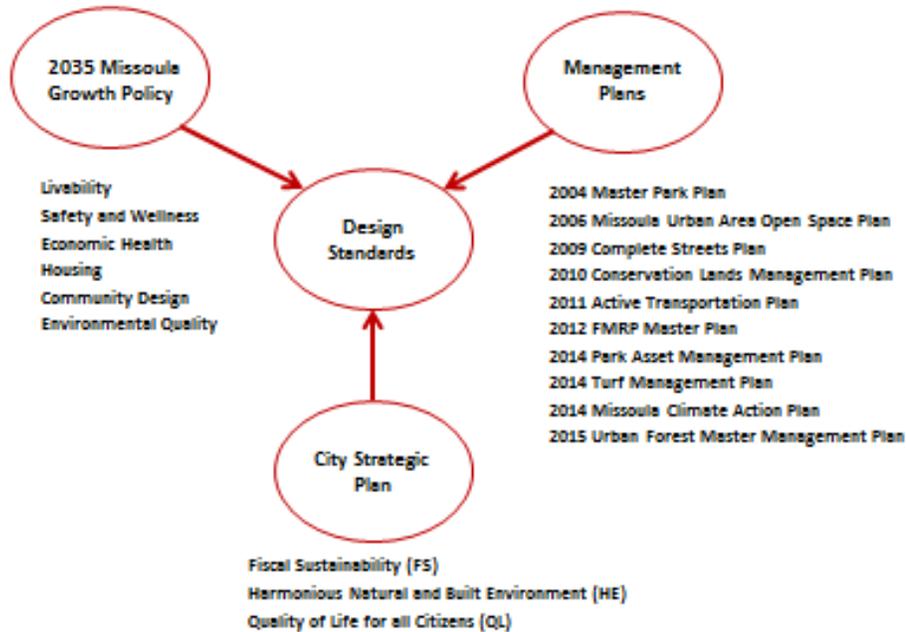


Figure 1. Foundational documents

PURPOSE

The purpose of this document is to provide direction to staff, landscape architects and contractors in the design, construction and maintenance of public landscape and recreation facilities in Missoula, Montana, in a manner that is sustainable and consistent with the city's foundational documents.

APPLICABILITY

Only improvements where the Missoula Parks and Recreation will assume operations and maintenance activities, or where maintenance and operation of city landscape facilities will be provided by others, such as a homeowners association or a real estate management agency, under a maintenance agreement with the City of Missoula, are subject to this design manual.

This design manual also applies to improvements within the public right-of-way adjacent to public parks and recreation facilities where the Missoula Parks and Recreation will assume operations and maintenance activities, or where maintenance and operation of city landscape facilities will be provided by others, such as a homeowners association or a real estate management agency, under a maintenance agreement with the City of Missoula

Boulevard landscaping installed and maintained by the abutting property owner as required in Missoula Municipal Code Section 12.48.030, Duty of landowner, is not maintained by the Missoula Parks and Recreation. **Therefore, the requirements of this manual do not apply to landscaping installed and maintained by the abutting property owner. See APPENDIX “K” (Clarification)**

INTENDED AUDIENCE

The intended audience of this manual includes landscape architects, engineers, architects and planners.

Agencies and individuals designing public park and landscape improvements covered by this manual must retain a landscape architect as the lead for the design process.

The design manual is not a substitute for professional experience. Sound judgment must be exercised in the application of the standards to specific circumstances. The standards do not preclude the use of different methods when special conditions or site specific conditions are a factor and when proper authorization is obtained.

This manual contains several individual parts, each with a specific task. The parts are written with a target audience in mind; not all parts are relevant to all audience members. Table 1 outlines each part, the purpose of each part and the target audience for each part.

Part	Section	Title	Purpose	Target Audience
1	General Requirements			All
	1	Definitions	Clear understanding	All
	2	Submittal Requirements and Procedures	Consistent submittals	Project Applicant Landscape Architect
2	Greenways and Horticulture Design Specifics			Specific
	1	Levels of Maintenance	Budget and staff forecasting	Project Applicant Landscape Architect
	2	Landscape Design	Consistent design	Landscape Architect
	3	Irrigation Design	Consistent design and optimal water usage	Landscape Architect, Certified Irrigation Designer

Part	Section	Title	Purpose	Target Audience
3	Crime Prevention Through Environmental Design			Specific
	1	Introduction	Clear understanding	Landscape Architect
	2	Four CPTED Principles	Site safety	Landscape Architect
	3	Design Specifics	Consistent design	Landscape Architect
4	Asphalt Pavement Design Guide			
			Consistent design and construction with optimal life cycles	Engineer
5	Park Facility Design Criteria			Specific
	1	Introduction	Clear understanding	Landscape Architect
	2	Natural Gravel Trails	Non-paved pathways	Landscape Architect, Engineer
	3	Park and Trail Lighting Design Standards	Consistent path lighting design	Landscape Architect, Engineer
	4	Turf Standards		Landscape Architect, Certified Irrigation Designer
	5	Wayfinding Bollards		Landscape Architect, Engineer

Table 1. Intended audience chart

PART ONE – GENERAL INFORMATION

SECTION 1: DEFINITIONS

When encountered in this manual, the terms below shall have the following definitions.

As-Built Drawings: Annotated construction drawings that show field modifications, adjustments or other changes deviating from the original construction drawings.

Back-up Landscape: The landscape area located between the back of sidewalk and the adjacent private property line, typically in association with "No Access Strips" and sound walls.

Boulevard: The area which exists in the public right-of-way between the edge of the public roadway, whether curbed or not, and the private property line.

Certified Irrigation Designer: An individual who is certified by the Irrigation Association to design irrigation systems.

Director: The Director of the Missoula Parks and Recreation, hereafter referred to as the director.

880 Principle: The design of parks and recreation facilities for individuals between the ages 8 and 80.

Greenway: A corridor of land used for active or passive recreational purposes, which typically includes an improved surface pathway. Greenways may be landscaped or in a natural state.

Landscape Architect: A landscape architect authorized to prepare and stamp landscape plans and specifications under Montana Code Annotated 37-66, entitled "Landscape Architecture" and Rule Chapter 24.114 of the Administrative Rules of Montana, entitled "Board of Architects and Landscape Architects", hereafter referred to as the landscape architect.

Level of Service: The frequency and intensity to which a specific landscape, hardscape and pathway improvement is maintained, hereinafter referred to as LLOS, HLOS and PLOS.

Median Island Landscaping: The landscape area located in the center of the roadway, typically between lanes of opposing traffic.

Maintenance Impact Statement: A spreadsheet that identifies maintenance activities specific to an improvement and the costs associated with the maintenance activities, hereinafter referred to as an MIS.

Maintenance Performance Specification: A spreadsheet that defines the design levels of service, components specific to the improvement and the maintenance schedule for those improvements,

hereinafter referred to as an MPS.

Native Plants: Trees, shrubs, groundcovers or perennials native to Montana.

Owner: The owner is the City of Missoula acting through Missoula Parks and Recreation.

Owner's Representative: The owner's representative is the Missoula Parks and Recreation Director acting directly or through a duly authorized Missoula Parks and Recreation employee, including, but not limited to, the Parks and Trail Design Development Manager, Parks and Trail Design Development Coordinator or City Forester, hereinafter referred to as the owner's representative.

Public Facilities: Public improvements operated and maintained by Missoula Parks and Recreation, or under agreement with Missoula Parks and Recreation, including, but not limited to, parks, greenways, median island and back-up landscapes and pathways.

Parks and Trails Design and Development Manager: The Missoula Parks and Recreation staff Landscape Architect responsible for facilitating public landscape and recreation facility improvements, hereinafter referred to as the PTDDM.

Public Facilities: Public facilities include, but are not limited to, municipal building grounds, boulevards, planting medians, parks, greenways, redevelopment projects, project portions to become property of or maintained by the Missoula Parks and Recreation, or under a maintenance agreement with the city.

Public Trees: Trees planted on median islands, back-ups, parks and other public facilities consistent with the Urban Forest Management Plan and selected from the City of Missoula approved street tree list.

Qualified Testing Laboratory: A testing laboratory meeting the Federal Highway Administration regulations entitled "Quality Assurance Procedures for Construction" and the AASHTO R18 publication "Standard Recommended Practices for Establishing and Implementing a Quality system for Construction Materials Testing Laboratories.

Return: The imaginary intersection of curb lines at a street corner.

Tree Class: The three height classes of street trees, which include Class I, 10' to 30' in height, Class II, 31' to 60' in height and Class III, 61' feet and greater in height at maturity.

SECTION 2: SUBMITTAL REQUIREMENTS AND PROCEDURES

The items listed below detail the minimum requirements and procedures for plan review with the Missoula Parks and Recreation.

Exception: Boulevard landscaping installed and maintained by the abutting property owner as required in Missoula Municipal Code Section 12.48.030 Duty of landowner.

CONSTRUCTION, PLANTING AND IRRIGATION DOCUMENTS

The following formats shall be used when drawing public facility plans in the City of Missoula. Unless otherwise noted below, these requirements apply to the cover sheet and all subsequent sheets.

- All sheets shall be drawn on a 24" X 36" (D) format sheet.
- Scale of plans shall be 1"=20' (Engineer's).
- Include a North arrow and a graphics scale on each sheet.
- Plans shall be submitted in a 24" X 36" (D) paper format sheet.
- Upon final approval, submit As-Built record plans in an e-transmitted .DWG, AutoCAD 2010 Drawing Format, and .PDF file format. Subsequent plan sets may be in 11" X 17" (B) format. Scales must be consistent and accurate in all plan sizes.
- The Title Block on each sheet shall include the project name, the name of the street or area where the project is located, the name and phone number of project owner and landscape architect, and the name of the contact person for the project.
- Project name, submittal name (e.g., 60% Submittal), and submittal date shall be placed vertically along upper right column of project cover sheet (with the intent that all can be read when drawings are rolled up)
- The limits of work shall only include areas within the public right-of-way or public property that are to be maintained by the Missoula Parks and Recreation. The project landscape architect is responsible for verifying the limits of work. Identify on the plans, the adjacent conditions and land uses that will affect the construction or operation of the improvements.
- The project landscape architect is responsible for verifying that the public facility, back-up or median island geometries are the correct configuration, including "as-built" conditions as shown on city file drawings.
- A location map that clearly shows the project site shall be placed on the project cover sheet. Major cross streets should be indicated on the location map. If there is more than one base sheet, include a key map on every sheet that shows the location of the work on that sheet in relation to the whole project.
- City standard detail sheets shall be used to depict construction, irrigation and planting details.

- Sound walls and/or fences located adjacent to back-up areas shall be clearly shown on all plans and labeled with type of material and height. Such structures shall clearly be shown as located on City or private property. Where the wall is to be located on private property the plans shall be labeled with the following note:

"Sound walls and/or fences may be a development condition attached to private property. They are not public improvements. All maintenance of sound walls and/or fences is the responsibility of the adjoining property owner, or homeowner's association."

Sound walls located on City property shall be permanent and low maintenance, constructed of concrete, concrete block or other alternate cementitious material. Surfaces shall be treated with an approved anti-graffiti coating. Contact the PTDDM for approved coatings or to seek approval of alternative coatings. Wood, stucco or other temporary material will not be accepted.

- Landscape detail and specifications sheets provided by the City shall be incorporated into the construction documents and noted as such. The sheets shall not be redrawn or revised without specific prior approval or direction from the PTDDM. Any approved revisions shall be clouded and noted. Details that do not apply to the project shall be crossed out and marked "void" or "omit".
- All plan sets shall include a base sheet identifying the locations of existing trees to be preserved, existing and proposed above and below ground utilities, easements, right-of-ways, street lights, traffic signals and other facilities which occur within or adjacent to limits of work. Below ground utilities which may affect installations or plantings shall be "potholed" to determine accurate depth prior to 60 percent plan submittal. The landscape architect shall determine the need for potholing.
- Project plans shall be prepared by, or under the supervision of, a licensed landscape architect. Final plan sheets must include the landscape architect's seal.

CONCEPTUAL PROJECT REVIEW

The landscape architect is encouraged to submit a conceptual landscape plan to the PTDDM for review to avoid extensive revisions of construction documents. This conceptual plan should address basic design issues, such as scope of project and expected level of service.

PROJECT REVIEW

All project plans submitted for preliminary, 30%, 60% and 90% review will be routed through the PTDDM. Two (2) complete plan sets, stamped "Preliminary-Not for Construction", including any backing documentation, must be submitted to start the project review process outlined below.

A preliminary Maintenance Performance Specification (MPS), sample shown in Appendix A, for the project must be included with the 30% plan submittal. A Maintenance Impact Statement (MIS), sample shown in Appendix B, must be provided with the 90% plan submittal. The MPS will be used during the 30% plan review to verify conformance with assigned levels of service and be used by staff to request any design changes.

The flowchart shown in Figure 2 illustrates the review process. The complexity of design will determine the scope of review. Simple designs may only require one or two reviews before approval is obtained and plans are signed. Conversely, complex designs may require multiple reviews with one or more city departments.

In order to facilitate project review, plan submittal packages must be assembled in the following order:

- Cover sheet
 - Project title
 - Vicinity map
 - Lead agency
 - Landscape Architect
 - Sub consultants
 - Owner
- Index sheet
- General note sheets
- Site overview sheets including all existing conditions, roadways, grades, dry and wet utilities and site constraints
- Grading plan sheets
- Utility plan sheets including all proposed dry and wet utilities
- Roadway and hardscape plan sheets
- Building plan sheets, if necessary
- Landscape planting plan sheets
- Irrigation plan sheets
- Detail sheets

Following the design review process, the project landscape architect shall submit a PDF file for the PTDDM's electronic signature. Each page of the FINAL landscape plan set shall be stamped, dated and signed by the landscape architect. Final plans submitted without the signed stamp will be considered as drafts and rejected. Estimated review time is 10 working days per submittal, based upon project size and scope.

Missoula Parks and Recreation Design Review Flow Chart

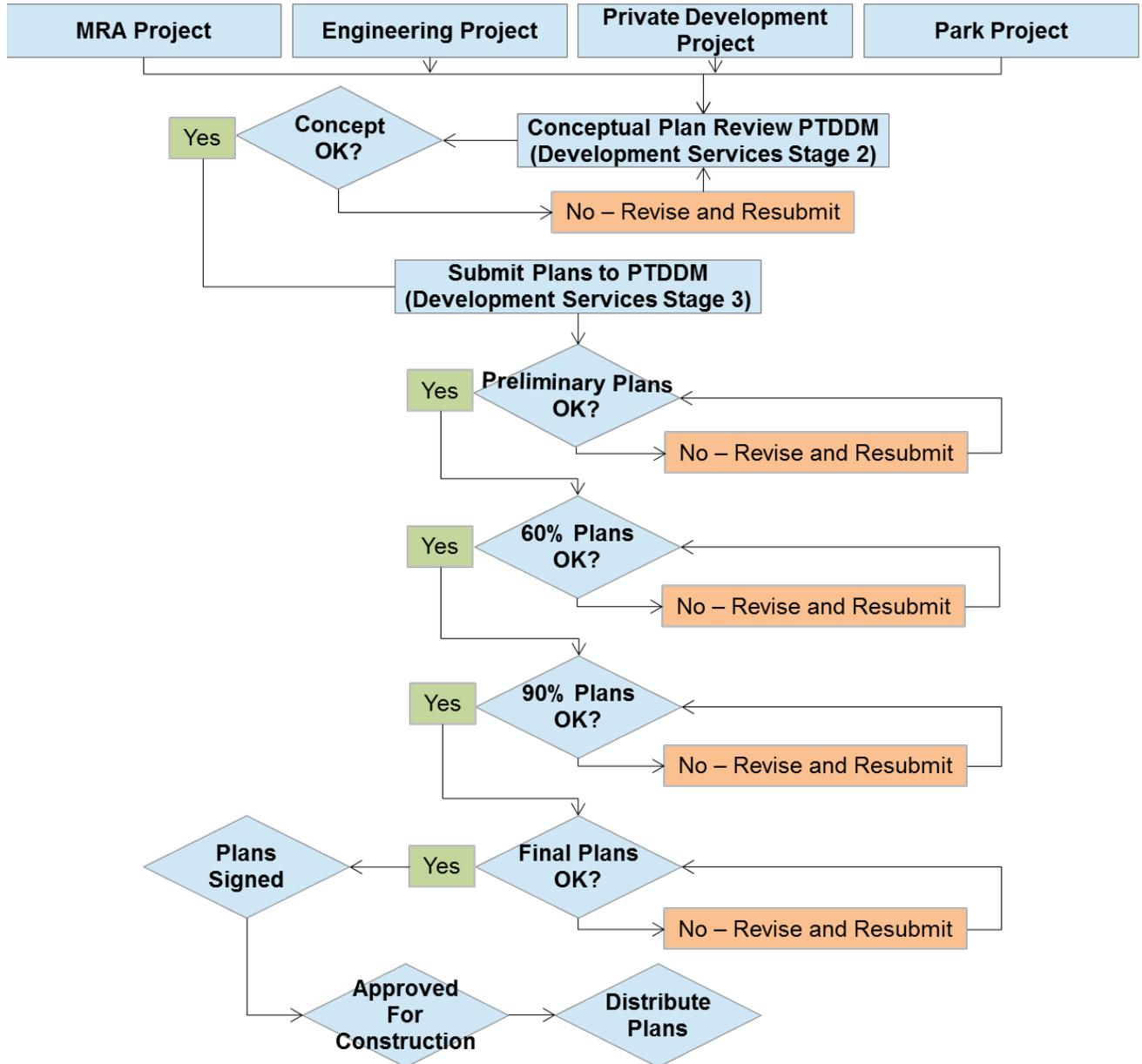


Figure 2. Design review flow chart

MAINTENANCE DOCUMENTS

Maintenance documents shall be submitted with the 60% review packet.

- **Levels of Maintenance Service:** Missoula Parks and Recreation has established a series of service maintenance levels for parks, pathways, median islands and other landscaped areas. The level of service designations are based upon the anticipated maintenance and operation costs and available funds for these areas. The levels of service are shown in the matrices at the beginning of each specific design section. The MPS and MIS will be used to develop budget requests and to make any adjustments in the level of service for a specific project.
- **Maintenance Performance Specification and Maintenance Impact Statement:** These documents shall provide detailed guidelines for an annual calendar of maintenance activities and a ten-year cost/budget assessment associated with maintenance and operation of the project improvements.

The MPS and MIS documents will be used by the Missoula Parks and Recreation as a permanent reference for the continued maintenance and cost accounting of the site. These documents shall be completed in the city's 8.5" x 11" EXCEL spreadsheet format and stapled together to the cover sheet. Refer to the sample MPS and sample MIS provided in Appendices A and B.

City maintenance labor costs vary over time and can affect the MIS. Contact the PTDDM for the most current city labor costs.

- **Irrigation Schedule:** Where irrigation will be installed, an irrigation schedule for the project shall be prepared for review and approval by Missoula Parks and Recreation.
 - The irrigation schedule shall show the following:
 - Valve number
 - Clock station number
 - Valve size
 - Design flow in GPM
 - Calculated flow velocity
 - Head type
 - Irrigation area
 - Upon completion of the design phase of the irrigation system, the irrigation designer shall submit data substantiating that the proposed design provides minimum distribution uniformity (DU) of 80%. No approval shall be granted by Missoula Parks and Recreation for any design not meeting or exceeding the criterion.

PROJECT SPECIAL CONDITIONS

Projects involving landscaping on Public Facilities to be taken over by the Missoula Parks and

Recreation for operations and maintenance will not follow the Montana Public Works Standard Specifications (MPWSS) language for “Substantial Completion.” These projects will follow the Missoula Parks and Recreation Completion Flow Chart shown in Figure 3 of this manual.

If MPWSS provisions will be incorporated into the aforementioned projects, the language in Appendix C shall be incorporated into project specifications. Appendix D contains the modifications to Section 00200 Instructions to Bidders, to Section 00500 Agreement Form and to Section 00700 General Conditions for Public Works Projects EJCDC 00700. These modifications and Supplementary General Provisions supersede the MPWSS language for Substantial Completion.

If MPWSS provisions will not be incorporated into the aforementioned projects, the City of Missoula Instructions to Bidders, Agreement and General Conditions, as supplemented or amended shall be used.

PERMITS

The landscape architect is responsible for verifying permit requirements for the project. Permits may include, but are not limited to, Building Permits, Plumbing Permits, Electrical Permits, Right-of-Way Permits, Storm Water Pollution Prevention Plan (SWPPP) Permits, Fence Permits or Encroachment Permits. Required permits shall be identified on the General Notes Sheet.

PARKLAND RESTRICTIONS

Public properties used as Parklands, Open Spaces, Trails, and landscape improvements in Rights-of-Ways are often subject to deed restrictions, subservient easements, regulatory requirements, and/or jurisdictional constraints that restrict use, development, types of improvements, maintenance activities and/or the ability to redevelop or use such properties. It is the project proponent’s and the landscape architect’s responsibility to research and determine what, if any, deed, easement, jurisdictional, and/or regulatory restrictions and rules apply to a specific property before developing project conceptual plans.

A summary of known Land and Water Conservation Fund sites can be found in Appendix H.

BIDDING

The owner’s representative may elect to attend the pre-bid meeting to address Missoula Parks and Recreation maintenance related issues or specific concerns. The complexity of design will determine the need for Missoula Parks and Recreation participation in the pre-bid process. Owner’s representative attendance at the pre-bid meeting will be determined by the landscape architect and owner’s representative in advance of the pre-bid meeting.

PROJECT INSPECTION

The owner's representative will attend the initial pre-construction meeting. At the pre-construction meeting, the owner's representative will determine which inspection and approval processes will be required:

- Submittal review
- Weekly progress meetings
- Plant material delivery
- Initial and final grading
- Initial irrigation layout and *mainline pressure* testing
- Hardscape layout
- Plant layout and initial planting
- Final planting inspection
- 90-Day maintenance inspection
 - Initial irrigation inspection and testing
- Post 90-Day maintenance inspection
 - Final irrigation inspection and testing
 - Warranty Inspection
- Final acceptance

The contractor will notify the owner's representative 48 hours (2 working days) in advance of the time and place of the pre-construction meeting.

The complexity of design will determine the scope of Missoula Parks and Recreation participation in the inspection process. Simple designs may require only minimal Missoula Parks and Recreation participation. Conversely, complex project designs may require multiple inspections with the Missoula Parks and Recreation or other city departments.

Please note, for Public Recreation Facilities projects, where the Missoula Parks and Recreation will assume operations and maintenance activities, there is no longer a substantial completion phase of the inspection process. Figure 3 illustrates the final inspection process.

Missoula Parks and Recreation Maintenance Completion Flow Chart

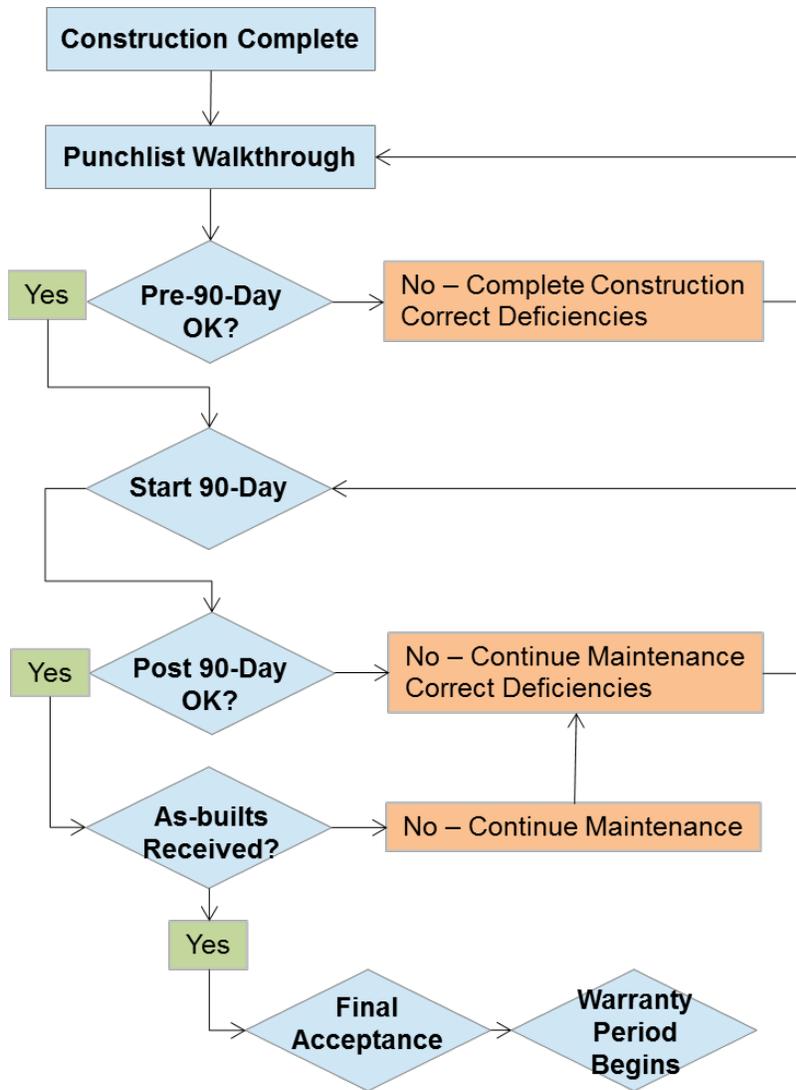


Figure 3. Maintenance period flow chart

PART 2 – GREENWAYS AND HORTICULTURE DESIGN SPECIFICS

INTRODUCTION

When designing public landscape, greenway and park facilities, the landscape architect must consider costs of construction and maintenance in relation to the benefit derived by the community. Proper design and effective use of the built environment can lead to a happy and healthy community, as well as plant and animal diversity within the community. The design expectations can be summed up by the following concepts.

- **Aesthetics:** Design facilities to project a positive image and establish a permanent character for the community and City. They should define a sense of place. They should provide places for groups and individuals for both formal and impromptu events. Overall, a sense of place and community should be created through the design of each facility.
- **Function:** Design facilities for all community members to use and enjoy using the 880 principles. Facilities must also be functionally designed for the people who maintain them.
- **Sustainability:** Design facilities for sustainable, long-term maintenance, requiring the fewest resources and consistent with the 2035 Missoula Growth Plan and the City Strategic Plan.
- **Ecosystem Services:** Design facilities in a manner that provides ecosystem services for the community, such air and water purification, nutrient cycling, and biodiversity. Of particular interest are facilities that benefit wildlife using city landscapes, greenways and parks. The degree to which ecosystem services can be provided likely depends on the location of the project, for example whether the project is located on a median island in Stevens Blvd or a park in the Target Range natural area.
- **Economics:** Design facilities for the allocated maintenance budget considerations and to provide economical means of maintaining the facility.
- **Tree Protection:** Design facilities to incorporate the tree preservation and protection measure required in Missoula Municipal Code Section 12.32.120.

PREFERENCE FOR NATIVE PLANTS

Citizens consistently value Missoula’s natural environment and the sense of place it creates. They value water conservation, promotion of habitat for wildlife and our regional beauty and biodiversity. All of these values can be supported by increasing the use of native plants in our municipal and public landscaping projects. When the appropriate native plant species are used for a particular site, the inputs of water, fertilizer, pesticides and maintenance can be much less than with non-native plants. Native plant selections appropriate for landscape use in Missoula are listed in Appendix E.

Native plants are also adapted to local herbivores, like deer and insects, and to our extreme changes in seasonal temperature and precipitation. Patches of native habitat on the local scale provide wildlife with food, shelter, and places to breed and raise young. On a broader scale, they enhance populations of wildlife by increasing carrying capacity, and enabling dispersal and migratory movement across the landscape.

Additionally, native plant materials are more likely to promote:

- An aesthetic that creates a sense of place (landscaping that looks like Montana).
- Wildlife conservation by providing habitat for birds and other pollinators.
- Reductions in fertilizer, water and pesticide usage.
- Preventing the release of new invasive species.
- Ecosystem services that are appropriate for Montana, including nutrient cycling, water cycling, soil retention and biodiversity.
- Economic responsibility by reducing the long-term inputs of water, fertilizer, pesticide, seasonal transplanting and more.
- Pollinator conservation, since native plants are usually the only caterpillar host plants for local butterflies.

NATIVE PLANTS AND MISSOULA’S EFFORTS TO BECOME A NATIONAL WILDLIFE FEDERATION CERTIFIED “COMMUNITY HABITAT”

In keeping with Missoulians’ value for wildlife conservation, in 2016 Mayor Engen committed to working with the National Wildlife Federation (NWF) to become the first certified “Community Habitat” City in Montana. This means that at a municipal level we are endeavoring to provide habitat for animals, especially birds and insects. The four necessary components of habitat are food, shelter, water and places to breed and raise young. On a broader scale, the enhance populations of wildlife by increasing carrying capacity and enabling dispersal and migratory movement across the landscape.

The NWF Community Habitat Program focuses on pollinator conservation. Pollinators provide vital services but their numbers are precipitously declining worldwide. Pollinator plants provide sustenance to migratory insects such as the Monarch butterfly and parochial insects such as bumblebees and mason bees. Migratory birds, such as hummingbirds, feed on flower nectar when passing through Missoula from Summer to Winter ranges. Best management practices are found in Appendix E.

Native plants are preferred for pollinator plantings <https://www.nwf.org/Garden-for-Wildlife/About/Native-Plants> and <https://www.nwf.org/en/Garden-for-Wildlife/Wildlife/Attracting-Butterflies>

Pollinators have different life stages (for example, caterpillar versus adult butterfly), and need different food sources at each stage. Adult butterflies can usually nectar at any available flower, but caterpillars often can only eat a limited palette of native plants.

BEST MANAGEMENT PRACTICES TO IMPROVE POLLINATOR HABITAT IN CITY LANDSCAPING

Pollinators provide vital ecosystem services but their numbers are precipitously declining worldwide. While there are multiple factors affecting this decline, several of the primary drivers of pollinator

loss can be alleviated by relatively simple changes in landscape design and land management practices. Urban areas often represent pollinator deserts, offering few resources to support local pollinator populations and posing significant barriers to pollinator migration. The design standards and best management practices outlined below will provide increased resources for pollinators in Missoula's urban landscaping.

- Incorporate a minimum of 50% NATIVE flowering plants in all landscape beds.
- Support all life stages (eggs and larvae) of pollinating insects by providing native plant materials wherever possible. Pollinators need more than flowers.
- Choose a suite of plants to provide floral resources from mid-march until mid-October.
- Maximize seasonal floral resources by selecting plant species with overlapping bloom times and perennial plants with long bloom periods.
- Provide resource for multiple types of pollinators by selecting flowering plants from multiple families with different flower shapes and colors.
- Provide a diverse array of cover by utilizing both deciduous and evergreen plants with varying heights.
- Incorporate Milkweed (*Asclepias*) species into landscaping to provide resources for the threatened Monarch butterfly. Preferred milkweed species for our region which also work well in landscaping include Showy milkweed (*A. speciosa*) for drier sites, and Swamp milkweed (*A. incarnata*) for wetter sites. (If there is concern that milkweed will spread too much for given planting design, they can be planted in a plastic pot with the bottom cut out, to greatly reduce spreading sideways.)
- Design planting beds to reduce weed densities (e.g., use weed fabric, limit overhead watering, use clean fill/composted material etc.) to limit need for herbicides. If herbicide applications are needed limit applications to times when pollinators are not active or when plants are not blooming. Do not use insecticides unless it is needed to protect public safety.
- Incorporate structures (e.g., logs, bee boxes, wooden fence posts) that promote nest sites for solitary bees. Allow for some unmulched areas and/or install soil pots 8-10in deep and/or top dress with compost (<1in deep) to provide for ground nesting pollinators.
- Consider adding water resources into landscape design. Even small catchments for rain and/or irrigation water are sufficient for most insect pollinators.
- In low-use irrigated lawns reduce mowing regimes to once every 2-3 weeks to promote flower resources. Incorporate natural meadows/grasslands which require little to no mowing into landscape design for unused park space.

SECTION 1: MAINTENANCE LEVELS OF SERVICE AND LANDSCAPE DESIGN

MAINTENANCE LEVELS OF SERVICE

The Missoula Parks and Recreation has established different levels of maintenance service for pathways, median islands and other landscaped areas which affect design criteria. The level of service designations are based upon the anticipated maintenance and operation costs and available funds for these areas. The MPS and MIS provided during the initial project review will be used to

determine the annual cost for the project site, and to make any adjustments in the level of service for a specific project.

- The Missoula Parks and Recreation will establish the level of maintenance service for a project site during the initial project concept discussions.
- The project landscape architect is responsible for verifying the initial level of maintenance service intended for the project site with the PTDDM.
- The project landscape architect must provide quantity take off data to the PTDDM prior to the 90% plan review.
- At 90%, the project landscape architect is responsible for coordinating with the PTDDM and developing a ten (10) year MPS and MIS for the project. Sample schedule and maintenance impact statements are provided in Appendices A and B.
- **Exception:** Boulevard landscaping installed and maintained by the abutting property owner as required in Missoula Municipal Code Section 12.48.030 Duty of landowner.
See APPENDIX “K” (Clarification)

Table 1. Landscape Level of Service (LLOS)

Level of Service	Description of Improvements	Typical Maintenance Activities
<p>Level 7</p>	<p>Landscaping in these areas consist of trees, woody and herbaceous shrubs, grasses, woody and herbaceous perennial-type ground covers, annuals, turf areas, automatic irrigation and significant soil preparation. Special features such as flags, fountains and specialty lighting may be incorporated into the design. Frequent annual color changes may be incorporated into the design. These landscape installations require the highest level of maintenance service and are reserved for areas such as municipal buildings, memorials, enterprise fund sites or other such areas.</p>	<p>Full service includes the following:</p> <ul style="list-style-type: none"> ○ All work is completed by 10 AM ○ Daily trash removal ○ Daily visual checks for damage or vandalism ○ Daily deadheading flowers as needed ○ Weekly landscape maintenance and weed control ○ Weekly turf mowing and trimming/edging ○ Weekly irrigation checks and maintenance ○ Weekly fountain maintenance ○ Periodic fertilization ○ Periodic aeration and top dress ○ Monthly surface cleaning ○ Monthly lighting check ○ Pest and insect control ○ Remove suckers and water sprouts from trees ○ Yearly soil pre-emergent application
<p>Level 6</p>	<p>Landscaping in these areas may typically consist of trees, woody and herbaceous shrubs, grasses, woody and herbaceous perennial-type ground covers, annuals, turf areas, automatic irrigation and significant soil preparation. Decorative pathway lighting may be installed. These landscape installations require a high level of maintenance service and are reserved for areas such as destination path rest areas, special assessment districts, municipal facilities, or other such areas.</p>	<p>Weekly service includes the following:</p> <ul style="list-style-type: none"> ○ Daily trash, litter and debris removal ○ Weekly landscape maintenance and weed control ○ Weekly turf mowing and trimming/edging ○ Weekly visual check for damage or vandalism ○ Weekly irrigation checks and maintenance ○ Periodic fertilization ○ Monthly lighting check ○ Deadhead flowers, where applicable ○ Pest and insect control ○ Remove suckers and water sprouts from trees ○ Yearly soil pre-emergent application

Table 1. Landscape Level of Service (LLOS)

Level of Service	Description of Improvements	Typical Maintenance Activities
Level 5	Landscaping in these areas consist of trees, woody and herbaceous shrubs, grasses, woody and herbaceous perennial-type ground covers, drought tolerant grass, soil preparation and automatic irrigation. Plant installation covers large areas. These landscape installations are reserved for median islands, back-ups, traffic circles and traffic chicanes where the city will provide maintenance and operation.	Weekly service includes the following: <ul style="list-style-type: none"> ○ Weekly trash, litter and debris removal ○ Weekly landscape maintenance and weed control ○ Weekly visual check for damage or vandalism ○ Weekly irrigation checks and maintenance ○ Periodic rough mowing ○ Pest and insect control ○ Remove suckers and water sprouts from trees ○ Yearly soil pre-emergent application
Level 4	Landscaping in these areas consists of trees, woody and herbaceous shrubs, woody and herbaceous perennial-type ground covers, drought tolerant grass, soil preparation, and automatic or manual irrigation. Plant installation is limited to specific areas. These landscape installations are reserved for traffic circles, traffic chicanes and major destination pathways. Maintenance may be conducted by the city, by others or by neighborhood volunteers.	Weekly/bi-weekly service including the following: <ul style="list-style-type: none"> ○ Weekly trash, litter and debris removal ○ Bi-weekly landscape maintenance and weed control ○ Weekly visual check for damage or vandalism ○ Weekly irrigation checks and maintenance ○ Periodic rough mowing ○ Pest and insect control ○ Remove suckers and water sprouts from trees ○ Selective or yearly soil pre-emergent application ○ Yearly Right-of-Way operations certification
Level 3	Landscaping in these areas consist of limited drought tolerant grass, tree or landscape plantings with temporary automatic or semi-automatic irrigation systems during the establishment period. These landscape installations are limited to landscape buffer zones, outlying destination paths, and passive use areas along paths.	Bi-weekly service includes the following: <ul style="list-style-type: none"> ○ Weekly trash can service ○ Bi-weekly to monthly service for mowing ○ Bi-weekly service for weed control and litter pick-up ○ Bi-weekly watering or irrigation check ○ Selective to yearly soil pre-emergent application

Table 1. Landscape Level of Service (LLOS)

Level of Service	Description of Improvements	Typical Maintenance Activities
Level 2	Landscaping in these areas consist of limited tree or shrub plantings without automatic or semi-automatic irrigation systems, which would receive trucked in water during a period of establishment. These landscape installations are typically limited to remainder parcels or areas along unpaved paths.	Monthly service includes the following: <ul style="list-style-type: none"> ○ Periodic service for mowing, weed control and litter pick-up ○ Monthly watering or irrigation check ○ Selective soil pre-emergent application
Level 1	Landscaping in these areas consists of native trees and vegetation or fallow land. Periodic weed control or mowing may occur. These areas typically include vacant path land or undeveloped median islands.	Twice-yearly service includes the following: <ul style="list-style-type: none"> ○ Periodic yearly service for weed control and litter pick-up ○ Selective soil pre-emergent application

Table 2. Hardscape Level of Service (HLOS)

Level of Service	Description of Improvements	Typical Maintenance Activities
Level 5	Hardscaping at this level consist of specialized surfaces such as terrazzo, stamped or inlaid concrete, concrete walls, or features such as fountains, raised lettering or recessed lighting. These hardscape installations require the highest level of maintenance service and are reserved for areas such as plazas, municipal buildings, memorials, enterprise fund sites or other such areas.	Weekly service includes the following: <ul style="list-style-type: none"> ○ Weekly service for weed control and litter pick-up ○ Weekly sweeping and/or washing ○ Weekly vandalism check ○ Weekly fountain check ○ Monthly power washing ○ Monthly lighting checks

Table 2. Hardscape Level of Service (HLOS)

Level of Service	Description of Improvements	Typical Maintenance Activities
Level 4	Hardscaping at this level consist of specialized surfaces such as terrazzo, stamped or inlaid concrete and specialized surface treatment such as interlocking pavers, dry stack walls or concrete masonry unit retaining walls. These hardscape installations require a higher level of maintenance service.	Bi-weekly service includes the following: <ul style="list-style-type: none"> ○ Bi-weekly vandalism check ○ Bi-weekly service for weed control and litter pick-up ○ Bi-Weekly sweeping
Level 3	Hardscaping at this level consist of specialized surfaces such as terrazzo, stamped or inlaid concrete and specialized surface treatment such as interlocking pavers. These hardscape installations require a higher level of maintenance service.	Monthly service includes the following: <ul style="list-style-type: none"> ○ Monthly service for weed control and litter pick-up ○ Monthly sweeping ○ Monthly vandalism check
Level 2	Hardscaping at this level consist of specialized surface treatment such as stamped concrete or interlocking pavers. These hardscape installations are limited to locations in need of highlighting, such as street corners or crosswalks.	Twice-yearly service includes the following: <ul style="list-style-type: none"> ○ Twice yearly service for sweeping, weed control and litter pick-up ○ Yearly paver reset after Spring thaw ○ Yearly soil pre-emergent application
Level 1	Hardscaping at this level consists primarily of asphalt paving or plain concrete. These hardscape installations require a low level of maintenance service and are reserved for areas such as median bullnoses, traffic circles or roundabouts.	Once-yearly service includes the following: <ul style="list-style-type: none"> ○ Once yearly service for sweeping, weed control and litter pick-up ○ Yearly soil pre-emergent application

Table 3. Pathway Level of Service (PLOS)

Level of Service	Description of Improvements	Typical Maintenance Activities
Level 4	On this type of pathway, the city maintains the path, shoulders, protective fencing and associated landscaping, The path surface is typically concrete or asphalt and is typically lighted.	Weekly service includes the following: <ul style="list-style-type: none"> ○ Weekly service for trash cans and litter pick-up ○ Weekly vandalism checks ○ Weekly check of fencing ○ Monthly lighting check ○ Monthly service for sweeping and weed control ○ Yearly soil pre-emergent application ○ Winter snow removal
Level 3	On this type of pathway, the city maintains the path, shoulders, protective fencing and associated landscaping, The path surface is typically asphalt and lighted.	Bi-weekly service includes the following: <ul style="list-style-type: none"> ○ Weekly service for trash cans and litter pick-up ○ Bi-weekly vandalism checks ○ Bi-weekly check of fencing ○ Monthly lighting check ○ Monthly service for sweeping and weed control ○ Yearly soil pre-emergent application ○ Winter snow removal
Level 2	On this type of pathway, the city maintains the path and shoulders. May have protective fencing. The path surface is typically asphalt.	Monthly service includes the following: <ul style="list-style-type: none"> ○ Monthly service for sweeping, weed control and litter pick-up ○ Monthly check of fencing ○ Yearly soil pre-emergent application ○ May have Winter snow removal
Level 1	On this type of pathway, the city maintains only the path. The path surface may be decomposed granite, cushion base or asphalt.	Once-yearly service includes the following: <ul style="list-style-type: none"> ○ Sweeping, weed control and litter pick-up ○ Yearly decomposed granite refresh ○ Yearly soil pre-emergent application ○ No Winter snow removal

LANDSCAPE DESIGN CRITERIA

Listed below are general design criteria for public landscapes. More specific design requirements are discussed in greater detail after the general criteria.

- Landscape plant materials for projects shall be selected from the City's Landscape Plant List in Appendix E. It is the project landscape architect's responsibility to provide necessary backing information for the plant choice should the landscape architect select plants not included on the city's list. Alternate selection must be approved by the PTDDM.
- Trees for use in the Public Right-of-Way shall be selected from the city's Approved Street Tree List and associated Neighborhood Planting Plans.
- The lowest water use plants shall be incorporated wherever possible.
- Where appropriate to the site and site conditions, the landscape architect must consider the use of native plants in the design.
- Landscape plants with a high potential for escape and establishment in natural areas shall not be used. See the invasive plant section of Appendix E.
- Plants selected for Missoula must be rated for a minimum of a USDA Zone 4.
- The landscape architect must take into consideration the plant's useful life span and cultural requirements. Plant materials shall be selected for their ability to adapt to the limitations caused by the existing site soils.
- Planting areas located in median islands and parking strips receiving shrub or ground cover massing shall not exceed 24" from top of curb. Where median and traffic circle plants are used for specifically for traffic calming, the selected plants may grow to a height of 60" above the top of curb.
- Decomposed granite surface treatment in lieu of mulch is to be used in park strips where foot traffic will occur. The decomposed granite surface treatment accommodates foot traffic and serves as mulch.
- Planting areas located between sidewalks and sound walls receive bark mulch for water conservation.
- Minimum plant container sizes shall be liner stock for grasses and herbaceous perennials, #1 (one gallon) for low growing shrubs, #5 (five gallon) for large shrubs and 2" B&B for trees. The city may require a smaller or larger container size be specified depending on special site requirements. Ground covers shall be planted from the size plant that will provide the fastest plant establishment for the chosen species.
- The Landscape Planting Plan shall provide a legend of the plant materials used in the project and provide the following information for each species: botanical and common names, container size, minimum size and height of plant in the container per the current ANSI Z60.1 Standards. If specific requirements for plants are used, include the requirements in the comments column.

- The plant materials selected for municipal facilities and the public right-of-way should be able to survive periods of water use restriction, while continuing to maintain an attractive appearance. Plant materials watered by a common irrigation circuit shall have similar watering requirements.

MAINTENANCE ACCESS AT MEDIAN ISLANDS

Maintenance access is required along all median islands providing with a minimum 1'-0" wide concrete band surrounding all planting areas to be installed at the back of curb. When calculating typical traffic speed, add 10 MPH to the posted speed limit. Refer to Table 4 for the appropriate access strip width for the project

Table 4. Median Access Strip Widths

Traffic Speed	Minimum Width	Comments
Posted 25 MPH +10	1'-6"	Stamped concrete may be used
Posted 35 MPH +10	2'-0"	Stamped concrete may be used
Posted 45 MPH +10	3'-0"	Access surface must be a medium broom finish

SELECTION AND LOCATION OF STREET TREES

Tree selections must be made from the approved street tree list or approved neighborhood planting plan. The selection of tree class and species shall be reviewed and approved by the City Forester, Missoula Parks and Recreation (406-552-6270).

All trees shall be located per the recommended minimum setbacks as follows:

Table 5. Tree Clearance Requirements

Location	Tree Type	Minimum Clearance
Adjacent to curbing or sidewalk	Class I	1.5' of curb face or sidewalk
	Class II	3' of curb face or sidewalk
	Class III	5' of curb face or sidewalk
Adjacent to any building or structure	Class I	4' of a building or structure
	Class II & III	10' of a building or structure
Adjacent to meter boxes and pad transformers	All Classes	10' of meter vault box or transformer pad
Residential driveways	All Classes	10' of a driveway
Commercial driveways	Class I	15' of a driveway
	Class II & III	10' of a driveway
Alleyways	Class I	15' of an alleyway
	Class II & III	10' of an alleyway

Table 5. Tree Clearance Requirements

Location	Tree Type	Minimum Clearance
Fire hydrants and utility poles	All Classes	10' of a hydrant or utility pole
Sanitary sewer lateral	All Classes	10' from sanitary sewer laterals
Street lights	Class I Class II & III	10' from street lights 20' from street lights
Traffic control signs	Class I Class II & III	40' in front of traffic control signs 25' in front of traffic control signs; trees may be planted adjacent to signs if the boulevard width is 10' or wider
Under power lines	Class I Class II & III	Allowed Not allowed
Corner sight triangle	Class I Class II & III	40' from intersection return 40' from intersection return on a boulevard width of 8' or less; 30' from intersection return on a boulevard width of 8' to 16'; and, 20' from intersection return on a boulevard width of 16' or greater.

While using the distances in the clearance table, the landscape architect shall space the street trees as equidistant as possible. Where site constraints prohibit planting trees using the minimums set forth above, the landscape architect may request a variance to the minimum setbacks. Approval of variances shall be at the discretion of the city forester based upon individual site conditions.

MINIMUM WIDTHS OF PLANTING AREAS

Obtain the minimum planter widths for trees from the Missoula approved tree list. Where a minimum planter width is not defined, use the default minimum planter width shown in Table 6.

Table 6. Planter Width and Spacing

Tree Type	Default Minimum Planter Width	Default Spacing
Class I broad canopy	3'	20' On-Center
Class I columnar	3'	10' On-Center
Class II broad canopy	6'	35' On-Center
Class II columnar	6'	20' On-Center
Class III broad canopy	10'	40' On-Center
Class III columnar	10'	25' On-Center

Table 6. Planter Width and Spacing

Tree Type	Default Minimum Planter Width	Default Spacing
Turf	10'	N/A
Shrub Beds	3'	N/A
Ground Cover Beds	2'	N/A

MINIMUM SOIL VOLUMES

For satisfactory, long-term landscape performance, adequate soil volume must be provided. Table 7 establishes the minimum soil volumes for landscape installations with trees.

Table 7. Planter Dimensions and Soil Volumes for Trees

Tree Class Type	Typical Planter Dimensions	Planting Strip Dimensions	Planter Soil Volume
Class I	5' X 6' X 5'	5' X 12' X 2.5'	150 cu ft
Class II	8' X 15' X 5'	10' X 24' X 2.5' 10' X 20' X 3'	600 cu ft
Class III	10' X 19' X 5'	10' X 38' X 2.5' 10' X 32' X 3'	950 cu ft

The minimum landscape planter depth where topsoil will be added is 18". The minimum median island planter depth where topsoil will be added is 30". To provide adequate soil oxygen and encourage optimal root growth, proper drainage must be provided for all planting locations. Scarify, or rip, the bottom of all planter pits before topsoil is applied. Where placed topsoil is different from the native soil, blend the first layers of placed topsoil to create a transition layer at least one foot thick.

Where existing site soil is to be used as the planting medium, scarify the soil to eliminate compacted soil layers. Scarify the soil to a minimum depth of 18" in planters, or until compacted soil layers are broken.

Where suspended pavement systems, such as Silva soil cells, Strata cells or root channels, are specified as a means of providing adequate rooting space under paved surfaces, the landscape architect shall develop construction specifications specific to the site. "Canned" manufacturer specifications showing generic layouts will not be accepted.

Structural soils, such as CU Soil, are not acceptable for attaining required soil volumes.

Alternate soil volumes or preparation techniques must be approved by the PTDDM.

ROOT BARRIERS

Specify 12" HDPE root barriers adjacent to sidewalks and 18" HDPE root barriers adjacent to curbing in planters or boulevards less than 8' wide where trees are to be planted, or where specified by the city due to specific site constraints. The minimum length of root barrier is 10', with the barrier centered on the tree. Examples of root barrier installation are shown in Detail PR-101-4

WEED BARRIER

When required for specific sites, weed barrier filter fabric underlayment must be non-woven Class A type equal to DMS-6200 Type 1, 4.0 oz. per sq. yd. to 6.0 oz. per sq. yd.

SIGHT VISIBILITY

Proposed plant materials shall not interfere with the sight visibility of vehicular traffic. The maximum right-of-way plant height, except for trees, established by the Missoula Municipal Code is 30". Proposed plants for boulevard strips shall not exceed 24" in height from top of adjacent curb. Where median and traffic circle plants are used for specifically for traffic calming, the selected plants may grow to a height of 60" above the top of curb.

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

Landscape designs shall incorporate CPTED principles as defined in Part 3. It is the responsibility of the landscape architect to coordinate with the Missoula Police Department on CPTED concerns for the site under design. If there are conflicts between CPTED principles, site and landscape design, contact the PTDDM for resolution before proceeding with additional design work.

SECTION 2: IRRIGATION DESIGN

DESIGN CRITERIA

The first and foremost consideration to be given in the design of the irrigation system is the performance of the system. Application methods that are the most efficient and effective for the location providing the maximum amount of water available to the plants with the least amount of water waste shall be used. In-line drip irrigation is the preferred method of water application in landscape beds. It is the designer's responsibility to investigate, determine and design the appropriate irrigation system for a specific site. Overspray on street and sidewalk paving shall be prevented through proper irrigation design.

The landscape architect shall determine the source of irrigation water; well or domestic service.

The Irrigation Plan shall provide an equipment legend which provides symbols of all equipment used on the plan, name of manufacturer and specifications. The Irrigation Plan shall identify the source of water and provide a valve chart of each control valve used in the project, and provide the following

information for each valve: number of valves, size, GPM, number of heads per valve, radius of spray or rotor heads, design psi, and the precipitation rate of each head.

When subterranean irrigation, drip irrigation or alternate irrigation is used, provide the following information for each valve: emitter flow rating, spacing or triangulation, flushing valves and other pertinent information.

The landscape architect shall complete a water demand sheet for the project. The demand sheet typically includes maximum irrigation system design flows, desired pressure and time of system operation, plus any additional information required by the water purveyor.

Provide a separate controller, meter and backflow prevention device, for city-maintained landscape areas. No shared utilities with adjacent private property.

The water meter, backflow prevention device and controller shall be located at back of sidewalk within the public right-of-way. The backflow prevention device shall be located no farther than 7' from the meter. A blow-out connection shall be placed in-line after the backflow. A drain shall be installed between the water source and the backflow.

Provide an electrical service for the irrigation controller. Where common site improvements are included in the project, add a 15 AMP circuit breaker to the service panel for the irrigation controller.

Verify with the local water utility company for the location and size of the water main and the available water pressure. Fill in the static water pressure information on the specifications sheet.

All irrigation systems shall be designed with a maximum water flow velocity of 5 FPS in both main lines and mainline laterals. Systems shall be designed so that water pressure shall not fall below the manufacturer's required pressure for optimal performance of pop-up nozzles and at rotor nozzles. Size all piping accordingly per manufacturer's specifications and flow tables.

Use a common trench for main supply lines and control wire conduit wherever possible. Sleeve all mains, laterals, and control wires under all pavement and types of pathway.

Spray heads shall not be used in the parking strip areas less than 4 feet wide. Trees and shrubs shall be irrigated with subterranean drip irrigation systems.

Provide a minimum of one quick coupler valve for each 1/2-acre of general landscape and every 250 lineal feet of roadway median island.

Missoula has variable prevailing winds, depending on the location and valley. When circuiting the spray heads, keep the upwind side on a separate valve from the downwind side. Where alternate irrigation methods will significantly reduce the amount of over spray, they shall be used in the landscape design.

All electrical control valve wiring shall be in a conduit.

Where future expansion of the landscape area will take place, extend the irrigation main line and control wire chase to both ends of the project site. Provide winterization blow-off valves at the end of stubbed mainlines. Show the location of blow-off valves on as-built plans. Contact the PTDDM for this information.

SELECTION OF IRRIGATION EQUIPMENT

To ensure the highest quality landscape installation and to facilitate efficient landscape maintenance, the City of Missoula has developed a set of minimum requirements for landscape materials. Listed below are the minimum required components for landscape irrigation systems. Acceptable approved equal equipment manufacturers can be found in Appendix “G”.

Where a landscape architect sublets irrigation design, the landscape architect is responsible for reviewing and approving the irrigation design for incorporation into the construction plan set.

Electrical Supply: The electric service panel shall be a TESCOFLEX® Single Meter Pedestal Model 26-000, or approved equal, meeting the following minimum requirements constructed to UL 508A standards and meeting EUSERC requirements; metered at 100 Amps and rated 120 to 480 volts; UL approved copper cable bussing and control wiring with seven (7) cable-in cable-out type circuit breakers; and, hot-dipped galvanized, aluminum or stainless steel all welded construction with no exposed fasteners and a vandal-resistant doors and hasp stress rated to 2,000 lbs. See Detail PR-119 for electrical service installation.

Well Controller: Well controllers shall be a Gould Aquavar SPD - Variable Speed Single Pump Drive or Franklin MonoDriveXT - Variable Speed Pump Drive, in a NEMA 3R enclosure for single phase, 208 to 230 volt, pump motors up to 2 HP; the well controller shall be a Gould AQUAVAR SOLO - Variable Speed Single Pump Drive or Franklin P-Series - Variable Speed Pump Drive, in a NEMA 3R enclosure for single/three phase, 200 to 230 volt and single/three phase, 380 to 480 volt pump motors 3 to 5 HP; or, approved equal Variable Frequency Drive with a pre-wired and test transducer, touch button pressure setting, full diagnostic, security and pump protection, dual phase, remote on/off, hand/auto operation, in a NEMA 3R enclosure. See Detail PR-120 for well control installation.

Well Pump and Motor: The well pump and pump motor shall be matched to the specified well controller. Size pump and motor to the area to be irrigated, and under no circumstances greater than 35 GPM, unless otherwise instructed. The pump and motor shall be designed to accommodate current and future irrigation demands for the site.

Y-Strainer: For well systems, a 2" Y-Strainer w/ a 120 Mesh poly ribbed stainless steel screen shall be installed between the pitless adapter and the backflow prevention device. The strainer shall be configured for manual flushing unless otherwise directed by the PTTDM. See Detail PR-109-1 for Y-strainer installation.

Controller: The controller shall be a Rainbird ESP series controller, or equal, with 12 to 48 station expandable unit suitable for indoor or outdoor application with a minimum of the following features battery backup, battery-programmable, cycle-soak, station delay, manual watering, master valve/pump start, non-volatile memory, rain delay, seasonal adjust and water budget; a minimum of 4 programs with a minimum of 8 start times per zone/program; a minimum of the following program cycles custom days of the week, odd days, even days, cyclical (water every x days), calendar day off, event days off; and, holding the following certifications UL, CUL, CE, CSA, C-Tick, FCC Part 15. Contact the PTDDM for specific controller specifications, such as 2-wire operation, on specific sites. See Detail PR-121 for controller installation.

Pedestal: The controller enclosure and pedestal shall be a Rainbird LXMMPED pedestal, or equal, constructed of a minimum of 12 gauge, powder coated steel. See Detail PR-121 for pedestal installation.

Control Wire: The minimum valve conductor size is 14 gauge. On extremely long project sites, provide voltage drop calculations for the conductors and increase wire gauge as directed by the landscape architect. All control wires shall be in conduit. Contact the PTDDM for 2-wire system requirements for specific projects.

Backflow Prevention Device (BPD): The reduced pressure principle backflow prevention device shall be a Wilkins Model 975 or Febco Model 825, or equal, constructed of brass with a head loss less than 15 PSI and meeting UL, AWWA, ASSE and CSA standards. If the water supply exceeds 80 psi, an appropriate pressure regulating device shall be installed. See Detail PR-109-1 for BPD installation.

BPD Enclosures: The enclosure for the backflow unit shall be expanded metal. For BPD's less than 2 1/2 inches, the enclosure shall be one piece. Where the BPD is greater than 2 1/2 inches, a clamshell type enclosure shall be used. Enclosures shall be painted with forest green eggshell enamel paint or powder coat with forest green pigment and lockable. The concrete pad shall provide oversized pipe openings around backflow piping. No Hotboxes or heated backflow enclosures are permitted. See Detail PR-109-3 for enclosure installation.

System Design Pressure: The system design pressure at the furthest head must be at least 35 PSI for pop-up heads and drip systems and 50 PSI for rotor heads.

Valves: Irrigation control valves shall be Rainbird PEB or PESB series remote control valves, or approved equal; Rainbird X CZ-100-PRB-LC or X CZ-100-PRBR for drip irrigation, or approved equal. See Detail PR-110 for valve installation.

Quick Coupler: Rainbird Model 44 LRC 1" quick coupling valve with rubber cover (RC), or approved equal. See Detail PR-112 for quick coupler installation.

Bodies and Spray Nozzle: Bodies shall be Rainbird 1800 series Stop-a-Matic (SAM) seal type with

pressure regulating stems; 6" for lawns and 12" for shrubs and ground cover, or approved equal. The required nozzles are Rainbird U or HE-VAN series, or approved equal with coefficient of uniformity of 0.85 or greater. See Detail PR-114 for pop-up spray installation.

Rotors: Rotor heads shall be Rainbird 3500, 5000, 6504 or 8005, or approved equal. The required nozzles are rain curtain series, or approved equal with coefficient of uniformity of 0.85 or greater. The landscape architect shall verify rotor size and nozzle type with the PTDDM. See Detail PR-113 for pop-up rotor installation.

Drip: Drip line shall be Netafim, or approved equal, with self-cleaning emitters. Tech-filter systems are not acceptable. See Detail PR-118 for subterranean drip installation.

Irrigation Lines: PVC piping shall meet ASTM D-1785 standards for Schedule 40 PVC pipe. Laterals shall be a minimum of SCH 40 PVC, 1" size. Main lines 2" and less shall be Schedule 40 PVC. Mainlines 3" or larger shall be Class 315. No mainline less than 1" in size.

Sleeves: Class 315 PVC, minimum 4" size for water lines and 3" size for electrical lines. For sleeves 6" and larger, the sleeve material shall be Schedule 40, or heavier, PVC pipe. High Density Polyethylene (HDPE) culvert material, meeting or exceeding MDOT specifications, may be used for sleeves greater than 6".

Conduit: Irrigation control wire conduit shall be Schedule 40 PVC, with a minimum diameter of 1 1/2". Electrical supply conduit shall be Schedule 40 PVC, with a minimum diameter of 3/4".

PVC Glue: Pipe glue shall be Regular-Bodied Clear cement for use on all schedules and classes of PVC pipe and fittings up to 4" for Sch. 40 and up to 2" for Sch. 80; Medium-Bodied Clear or Medium-Bodied Gray cement for use on all schedules and classes of PVC pipe and fittings up to 6" for Sch. 40 and up to 3" for Sch. 80; Lo-V.O.C.; meeting ASTM D-2564; suitable for potable water, pressure pipe and conduit; and, with a recommended application temperature 40°F to 110°F. **Red-Hot Blue glue shall not be used.**

PVC Primer: Primer shall be Purple-tinted primer for use on PVC pipe and fittings; Lo-V.O.C.; NSF listed; and, meeting ASTM F-656.

PART 3—CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

SECTION 1: INTRODUCTION

When designing public landscape, greenway and park facilities, the landscape architect must consider public safety in the overall design. Proper design and effective use of the built environment can lead to a reduction in fear, the incidence of crime and an improvement in the quality of life.

SECTION 2: FOUR CPTED PRINCIPLES

Natural Surveillance: The organization of physical features, activities and people in such a way to maximize visibility. It creates a risk of detection to intruders and offenders and a perception of safety to legitimate users. This principle is based upon the premise that criminal activity is generally reduced when an area is being observed informally by others who are present or nearby.

Natural Access Control: Would-be perpetrators of crime like settings or environments they can enter or leave without being noticed. Natural access control is the physical guidance or people coming to or people going from a space by the judicious placement of entrances, exits, signs, fencing, landscaping and lighting. Natural access control places users of space in locations where natural surveillance potentials exist.

Territoriality: Is used to distinguish public and private spaces. The idea is that someone owns and cares about this space. If not used for legitimate park activities, it can quickly be used for some illegitimate, illegal activity. The more people who use the facilities the way they were intended, the safer those areas are going to be.

Maintenance: Without proper maintenance, a public area is inviting to criminal behavior.

SECTION 3: DESIGN SPECIFICS

When designing public landscape, greenway and park facilities, incorporate the concepts listed below into the design. It is the responsibility of the landscape architect to balance function, form and safety in the overall design.

Good Design Components

- Design the park with safety in mind.
- Increase the opportunities for informal surveillance and reduce the number of isolated places where crime can take place unseen.
- Ensure clear sightlines that allow users the ability to verify the presence of persons they might find threatening.
- Avoid shrubbery, fences, walls, sharp corners, storage sheds or art work that hinder visibility.
- Create an active park edge for a perimeter of surveillance.
- Locate restrooms/washrooms beside a major activity area or entrance to the park.

- Create an easy to navigate layout.
- Provide easy pedestrian circulation with well-defined boundaries. Avoid movement predictors and entrapment areas.
- Include proper/clear signage, such as encouraging users to report suspicious activity.
- Concentrate nighttime pedestrian movements and light pathways sufficiently with varying intensities to avoid glare and shadows.
- Ensure lighting extends beyond the pathway edge to illuminate potential concealment areas.
- Place signage so it is visible from the street to encourage use by passersby.
- Avoid surfaces that are easily vandalized or used for inappropriate activities.

Poor Design Components

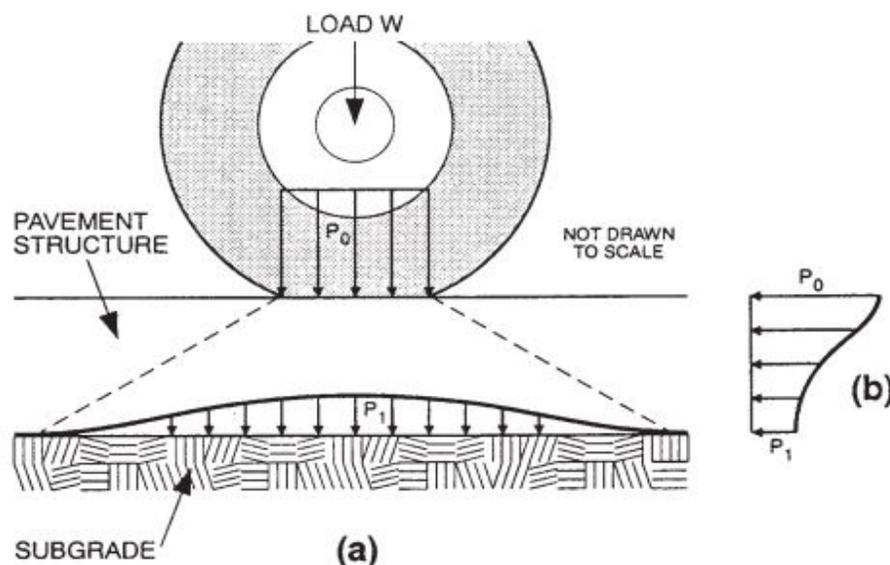
- Poor or insufficient lighting.
- A confusing layout.
- Physical isolation.
- Areas of concealment.
- No access to help.
- Difficult to maintain.
- Easy to vandalize
- Hangouts for what the general public considers “undesirable behavior.”

**PART 4 – ASPHALT PAVEMENT DESIGN GUIDE
FOR THE CITY OF MISSOULA MISSOULA PARKS AND RECREATION
For Design and Construction of Trails and Parking Lots**

General Note: This section refers to asphalt pathway and parking lot paving. The design and construction of natural, non-paved, surfaced paths and trails is covered in Part 5.

SECTION 1: SOIL SUPPORT

The ability of the subgrade to support loads transmitted from the pavement is one of the most important factors in determining pavement thickness. The subgrade must serve as a working platform to support construction equipment and as a foundation for the pavement structure that supports and distributes traffic loads. Thus, it is essential to evaluate the strength of the subgrade before beginning the structural design of the pavement. The figure below shows the spread of wheel load through the pavement structure and on to the subgrade.



Courtesy of Asphalt Paving Association of Iowa.

If sufficient pavement thickness is not provided, the applied loads could cause greater stresses on the subgrade than it can resist. This may result in deflection of the pavement and ultimately in its failure.

The subgrade provides the foundation for the pavement. Different types of soils have different abilities to provide support. A sandy soil, for example, will support greater loads, without deformation, than a clay soil. Thus, for any given traffic volume and weight of vehicles using the pavement section, a greater pavement thickness must be provided on clay soils than on sandy soils.

A.1 Soil Classifications

Soil is classified for pavement sections in order to predict subgrade performance on the basis of a few simple tests. The American Association of State and Highway Transportation Officials (AASHTO) classification system for soils is commonly used as a test for subgrade-support value. According to the AASHTO system, soils that have approximately the same general load carrying capabilities are grouped in classifications of A-1 through A-7. In general the best highway subgrade soils are A- 1, and the worst are A-7. The classification is based on the sieve analysis, plasticity index, and liquid limit of the soil being tested.

A.2 AASHTO Soils Classification Tables

General Classification	Granular Materials (35% or Less of Total Sample Passing No. 200)							Silt-Clay Materials (More than 35% of Total Sample Passing No. 200)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group Classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, percent passing: No. 10 No. 40 No. 200	50 max 30 max 15 max	50 max 25 max	51 max 10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40 Liquid Limit Plasticity Index	6 max		NP	40 max 10 max	41 min 10 max	40 max 11 min	41 min 11 min	40 max 10 max	41 min 10 max	40 max 11 min	41 min 11 min
Usual Types of Constituent Materials	Stone Fragments, Gravel & Sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Rating as Subgrade	Excellent to Good							Fair to Poor			

A.3 Subgrade Strength

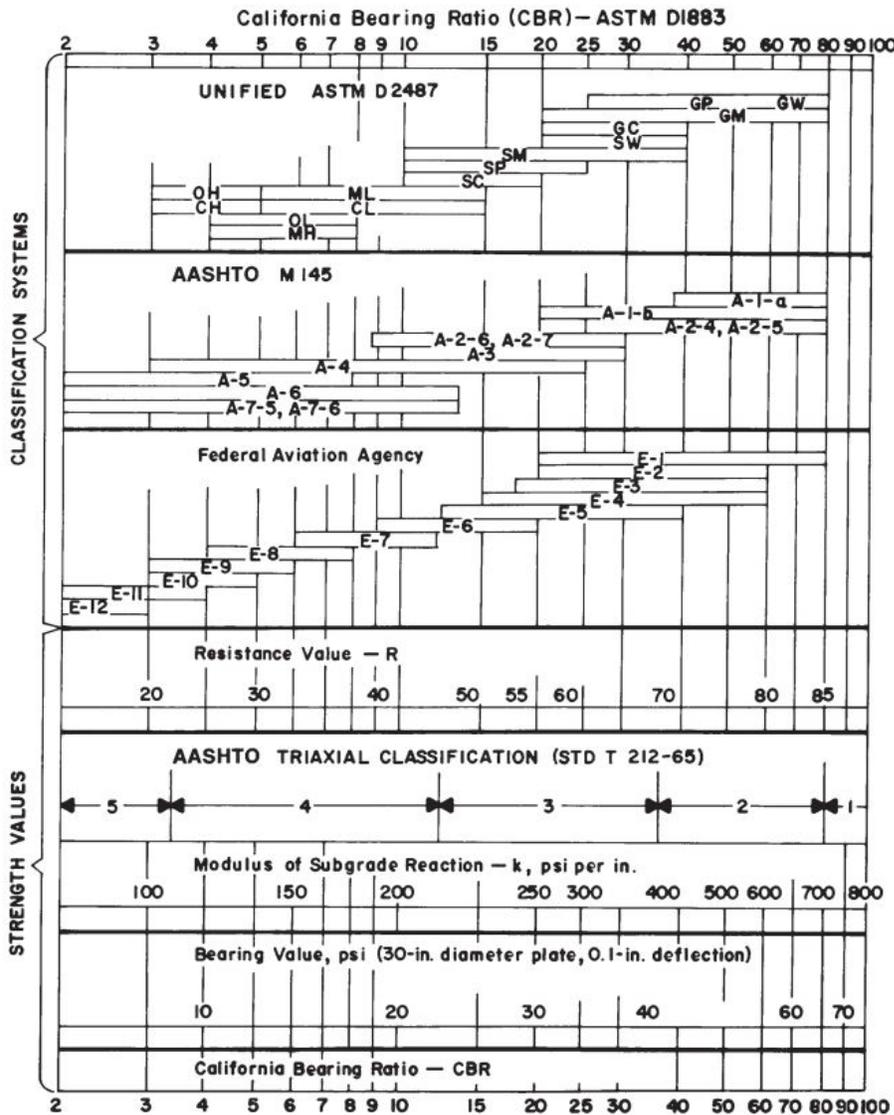
Because thickness calculations depend on the strength of the finished subgrade, the soil must be tested for this information. Tests are based on bearing capacity related to the moisture and density of the soil. The California Bearing Ratio (CBR) is one of the most widely used methods of designing pavement structure. Once the CBR value is determined, the soil classification can be identified. Or, when the soil classification is known, a relative CBR value can also be identified.

The lower the CBR value of a particular soil, the less strength it has to support the pavement. This means that a thicker pavement structure is needed on a soil with a low CBR rating than on a soil with a high CBR rating. Generally, clays have a CBR classification of 6 or less. Silty loam and sandy loam soils are next with CBR values of 6 to 8. The best soils for road building purposes are sands and gravels whose CBR ratings normally exceed 10.

The change in pavement thickness needed to carry a given traffic load is not directly proportional to the change in CBR value of the subgrade soil. For example, a one-unit change in CBR from 5 to 4 requires a greater increase in pavement thickness than does a one-unit CBR change from 10 to 9.

A.4 Soil Classification Correlation

A number of soil classification-strength systems are currently in use for roads and airports. A correlation chart follows for a general soil overview.



Courtesy of Asphalt Paving Association of Iowa.

B.1 Soil Testing

A qualified laboratory shall conduct tests to provide soil classification and subgrade strength information (such as the CBR). Such testing is necessary to ensure a proper structural design and is part of all major projects. The dynamic cone penetrometer (DCP) can also be used for measuring the soil strength. It can be directly related to the CBR value using empirical relationships. Refer to ASTM D6951 – Standard Test Method of the Use of Dynamic Cone Penetrometer in Shallow Pavement Applications.

Actual strength testing to characterize the subgrade support is better than that provided by a simple soil classification. The need for strength testing becomes increasingly warranted as the consequences of pavement failure increase.

C.1 Seasonal Variations

In determination of the strength of the subgrade, seasonal variation of the strength of the soil should be evaluated to determine the effective roadbed soil resilient modulus which is used in the determination of the section thickness. The purpose of this evaluation is to quantify the relative damage a pavement is subjected to during each season of the year and treat it as part of the overall design. This evaluation is best performed by a consultant that is experienced with the procedure as described in the AASHTO -1993 Guide for the Design of Pavement Structures.

D.1 Subgrade Classes

For the designs recommended in this guide, all soils have been divided into three classes: Good (G), Moderate (M), and Poor (P), CBR design values are assigned to these different subgrade classes.

Good

Good subgrade soils retain a substantial amount of their load-supporting capacity when wet. Included are the clean sands, sand gravels, and those free of detrimental amounts of plastic materials. Excellent subgrade soils are relatively unaffected by moisture or frost and contain less than 15 percent passing a No. 200 mesh sieve. A soil classified as good will have a CBR value of 9 or greater.

Moderate

Moderate subgrade soils are those that retain a moderate degree of firmness under adverse moisture conditions. Included are such soils as, silty sands, and sand gravels containing moderate amounts of clays and fine silts. When this soil becomes a cohesive material, it should have a minimum proctor density of 110 pounds per cubic foot. A soil classified as moderate will have a CBR value of 6 to 8.

Poor

Poor subgrade soils are those that become quite soft and plastic when wet. Included are those soils having appreciable amounts of clay and fine silt (50 percent or more) passing a No. 200 sieve. The coarse silts may also exhibit poor bearing properties in areas where frost penetration into the subgrade is encountered for any appreciable periods of time. This also is true where the

water table rises close to the surface during certain periods of the year. A soil classified as poor will have a CBR value of 3 to 6.

Very poor soils (those with a CBR of 3 or lower) often perform poorly as pavement subgrades. However, to improve their performance, these soils can be stabilized with granular material or a geotextile. Lime, fly-ash, asphalt cement, Portland cement, and combinations of cement stabilizers also can be added to improve the subgrade support. The selection of a stabilizing agent, the amount to use, and the application procedure depend on the soil classification and the subgrade support value desired. These should be determined through appropriate laboratory testing.

SECTION 2: GEOTEXTILES

In the event that testing reveals unstable or unsuitable materials in a project's proposed location for the pavement section, consideration shall be given to the potential use of geotextile materials to modify and improve the substandard or questionable subgrade. The choice to use geotextiles vs other types of augmented stabilization or removal and replacement must be determined on the most cost-effective basis given long-term evaluation.

The project civil engineer, using data supplied by the geotechnical engineer, will determine the need for geotextiles, the type and weight of geotextiles to be used and the extent of geotextile use.

SECTION 3: DRAINAGE

A.1 General Considerations

Engineers recognize the importance of good drainage in the design, construction, and maintenance of any pavement. Probably no other single factor plays such an important role in determining the ability of a pavement to provide trouble-free service throughout long periods of time.

The accumulation of water in the subgrade, or in an untreated aggregate base course, usually creates problems. When the soil is saturated, application of dynamic wheel loads induces pore pressures and lowers the resistance to shear. Some soils have a high volume change (when water is added), which causes differential heaving. The subsequent weakening of the pavement structure causes it to lose stability and its capability to support traffic loads.

The combination of water in the pavement's asphalt layers and dynamic, repeated traffic loading can strip or separate the asphalt film from the aggregate. This reduces the load carrying capacity of the pavement itself.

When developing the features of a drainage system, it is important to consider the system's principal purposes: (1) to collect and drain away both surface water and subsurface water; (2) to lower the groundwater table, if necessary; (3) to intercept water from surrounding areas and carry it away from the roadway; and (4) to prevent or retard erosion.

There are two basic categories of drainage – surface and subsurface. Surface drainage includes the disposal of all water present on the pavement surface, shoulder surface, and the adjacent ground when sloped toward the pavement. Subsurface drainage deals with water in the subbase, the surrounding soil, and in the several pavement courses. Inadequate attention to either of these two drainage conditions can lead to premature pavement failure.



A.2 Surface Drainage

In surface drainage conditions, the pavement and shoulders must be crowned or cross-sloped to facilitate the flow of water off of the roadway. Normally, the cross-slope moves the water to a curbed or inverted shaped gutter and then off of the pavement into a storm sewer, sump or flume to a ditch. In the case of trail design, crowned pavement sections are not acceptable due to the trail's typical width in relation to the width of snow removal equipment. The trail pavement section design must be cross-sloped (straight grade) and/or vertically curved to induce runoff and maintain a flat surface for snow removal. Trail pavement sections must be designed to be constructed higher than the surrounding topography such that drainage flows away from the trail and disposed by the most appropriate means mentioned here-in.

In parking areas or playgrounds, the cross slope or crown may be inverted toward a center swale with a grated inlet for drainage interception.

Shoulders can best be drained if the entire shoulder width has an asphalt-paved surface. If the shoulder is not asphalt, its cross-slope should be made steeper in order to minimize seepage through the aggregate or grass shoulder.

Surface drainage from the pavement and from the adjacent land areas must be intercepted and disposed of. If a curbed section is provided, drainage is accumulated in the gutter area and periodically discharged into either a pavement inlet or a ditch through a flume. The determination of inlet locations requires technical calculations to maintain a tolerable spread of water on the pavement. MMC requires all parking lots over 4 spaces to be constructed with poured in place curb (no pin downs allowed).

Drainage ditches are constructed along the edges of non-curbed roadway sections. Water flowing from the pavement and shoulder surfaces is moved down the roadway foreslope into a rounded ditch area. A backslope leads from the bottom of the ditch up to intercept the adjacent land. The adjacent land is frequently sloped toward the ditch and can contribute to a sizable portion of the drainage flow.

Good design practices will provide cross-slopes both on the surface and in the underlying pavement courses and subgrade. In this way, water will not accumulate but will flow laterally to the sides.

B.1 Subsurface Drainage

Subsurface water is free water that percolates through, or is contained in, the soil beneath the surface. When it emerges or escapes from the soil, it is referred to as seepage water. The point of emergence is called a seepage area or a spring.

Pavement subsurface water usually is present as free water that flows under the force of gravity or as capillary water that moves under capillary action in the soil. Geotechnical observance and testing often provides for proper identification and suitable treatment of subsurface water. Further, it can save costly change orders in the project's progression.

Water will often rise from the underlying soil through the subgrade and into an untreated aggregate pavement course. This free water will move readily through an untreated aggregate base to a low point on the profile. If steep grades are present, and the subsurface water flowing in an untreated aggregate base to the low spot is not intercepted, a hydrostatic head may result. This lifting force will cause a failure of the pavement structure. Water in the pavement courses also may contribute to the stripping of asphalt films from the aggregate particles, especially in roadway sections.

B. 2 Subdrains

When water collects in the structural elements of the pavement, subdrains are required. Identification of these areas and determination of drain locations require the technical expertise and insight of an engineer. The choice of drain filter material and the design of the drainage system must be given careful attention by experts. Perforated and slotted pipe usually serve to move the free water from the trouble spot to a drainage area.

B.3 Field Inspection During Construction

Regardless of the care used in the preliminary investigation, the soil survey, and in the pavement structure's design, it is usually not possible to determine from borings the exact elevation of water-bearing strata or the rate of flow that will develop. For this reason, it is essential that the engineer reevaluate the field conditions and check the need for, and the adequacy of, any subsurface drainage indicated on the plans.

Soil conditions should be observed during the grading and subgrade preparation work. Any wet, soft, or spongy areas encountered at grade should be investigated and provisions made for their proper drainage. Even a minor rate of seepage may build up to a large quantity of water over a period of time if a means of escape is not provided. Such a soft spot usually forewarns of a structural failure at a later date-even shortly after traffic has used the new facility. After the pavement is in place, corrective measures are costly, create traffic problems, and can cause poor public relations.

SECTION 4: THICKNESS DESIGN FOR PARKING LOTS

Design thicknesses given in this section are minimum values calculated on the volume and type of traffic that will use the facility and on the load-supporting capability of the underlying soils.

Special truck lanes are sometimes required to expedite traffic to loading areas, trash dumpster sites, and equipment areas. Design thicknesses for these lanes or pavement areas should be increased. Drainage problems are also a major cause of pavement failures. Their significance warrants a special section on drainage that should be reviewed before selecting a pavement design either from this guide or from any other source.

A.1 Design Procedure

The tables below can be used directly to select design thicknesses for a number of design input factors. To use the tables, appropriate traffic and subgrade classes must be selected as follows.

A.2 Design Steps

The following steps can be used to determine a pavement thickness.

1. Using the number of parking spaces to be marked, select the traffic class (less than 50 spaces, 50 to 500, more than 500, or industrial) to be used. Determine if any areas will receive heavy truck traffic and the percentage of truck traffic.
2. Using soil data from the project, select a subgrade class (good, moderate, or poor). If no soil information is known, use the poor classification for the subgrade. (If the CBR value for the soil lies between the values given, use the lower classification.)
3. Using the selected traffic and subgrade classes, select a design thickness from the tables below.

A.3 Design Example

1. A new department store wishes to place a 350-car parking lot in front. A truck loading zone and dumpster site will be placed in back.
2. No soil data are known, so the engineer selects the poor soil classification.
3. From the tables, the total depth of pavement section is 11 ½ inches consisting of 8 inches of base course aggregate and 3 ½ inches of AC surface course. For the truck loading zone and approaches, from the tables, the total thickness is 8 inches consisting of 6 inches of AC base and 2 inches of AC surface course. It should be noted that base aggregates can be used to replace the AC thickness to reduce costs at a specified ratio.

B.1 Pavement Thickness Tables – Parking Lots

The pavement thickness for **Parking Lots** should be in accordance with the following table:

Design Criteria*			Thickness in Inches		
Traffic Class (Spaces)	Subgrade		Aggregate Base Course	Asphalt Concrete	Total
	Class	CBR			
I (< 50 spaces)	Good	9	4.0	3.0	7.0
	Moderate	6	4.0	3.0	7.0
	Poor	3	6.0	3.0	9.0
II (50-500 spaces)	Good	9	4.0	3.0	7.0
	Moderate	6	6.0	3.5	9.5
	Poor	3	8.0	3.5	11.5
III (500 and above spaces)	Good	9	4.0	3.0	9.0
	Moderate	6	8.0	3.5	11.5
	Poor	3	8.0	4.0	12.0

*See Section 1 SOIL SUPPORT for traffic and soil classification details.

B.2 Heavily-Loaded Areas

The pavement for entrances, frontage roads, trash dumpster sites, and delivery truck parking, as well as the approach areas to these spaces, must be increased in thickness to prevent pavement failure caused by the weight and dynamic loading. These areas should be constructed with concrete or full-depth asphalt in a thickness that will support this special type of pavement loading. Failure to provide this strengthening can result in severe pavement failure.

The pavement thickness for Heavily Loaded Areas in Parking Lots should be in accordance with the following table:

Design Criteria*			
Traffic Class (Spaces)	Subgrade		Full Depth Asphalt Concrete (inches)
	Class	CBR	
I-III (Up to 20 heavy trucks per day)	Good	9	6.0
	Moderate	6	7.0
	Poor	3	8.0
IV (20 to 200 trucks per day)	Good	9	7.5
	Moderate	6	8.5
	Poor	3	9.5

*See Section 1 SOIL SUPPORT for traffic and soil classification details.

SECTION 5: CONSTRUCTION PRACTICES – PARKING LOTS

A.1 Subgrade Preparation

All vegetation (including root systems), rocks, debris, and topsoil should be removed from the area to be paved. To prevent future growth, the subgrade should be treated with an approved soil sterilant. Install drainage and utility facilities; backfill and compact. Adjustments in utilities or underground facilities can be readily accomplished through the asphalt base should changes occur.

The subgrade must be properly shaped to meet true lines and elevations. It must be compacted to not less than 95 percent of maximum laboratory density. Proof rolling may be used on oversized (non-proctorable material) subgrade. The surface of the compacted subgrade must not deviate by more than 3/4 inch from the established grade. A maximum slope of about 2 percent or 1/4 inch per foot should be maintained to provide adequate drainage of surface water from the finished pavement and meet ADA requirements.

Areas that show pronounced deflection under construction traffic indicate instability in the subgrade. If reworking and additional rolling do not correct the situation, the area soil must be removed, replaced with suitable material, and compacted. The use of asphalt-treated base or coarse granular material is recommended.

B.1 Asphalt Lift Thickness

Nominal aggregate size dictates lift thickness. Minimum lift thickness should be at least 3 times the nominal maximum aggregate size to ensure aggregate can align themselves during compaction to achieve required density and also to ensure mix is impermeable. Therefore, the desired lift thickness can direct the decision on nominal aggregate size to use.

The maximum lift thickness is dependent also upon the type of compaction equipment that is being used. When static steel-wheeled rollers are used, the maximum lift thickness that can be properly compacted is 3 inches. When pneumatic or vibratory rollers are used, the maximum thickness of lift that can be compacted is almost unlimited. Generally, lift thicknesses are limited to 6 or 8 inches for base course asphalt. Proper placement becomes a problem in lifts thicker than 6 or 8 inches.

C.1 Base-Platform Construction

Asphalt Concrete Base Material must be placed on the prepared subgrade. A base of 4 inches or less in depth should be placed in one lift. A base of a total thickness of more than 4 inches may be placed in two or more lifts with the bottom lift being a minimum of 3 inches. The material must be spread and compacted to the required thickness and density as specified and in the grades and dimensions shown on the plans. The surface of the base must not deviate more than 1/2 inch when measured with a 10- foot straight edge.

D.1 Surface Course Construction

When construction entails building construction; after building construction is essentially completed, and all building materials and offices have been removed from the previously paved base, preparation for placement of the Asphalt Concrete can begin. Should building operations or winter weather delay the placement of the final surface, the Asphalt Concrete base will adequately serve traffic needs during the interim provided drainage accommodations are made.

In some cases to provide adequate section stability, the proper section design may include a middle or “binder” course of medium aggregate size. This is often done where the finish course is designed to be a wearing course and sacrificial for future overlayments.

Preparation for the surface course requires thorough cleaning and sometimes washing of the asphalt base to remove tracked-on dirt and foreign particles. After cleaning, any cracked or broken areas in the base should be removed, replaced with bituminous mix, and thoroughly compacted. All manholes, valve boxes, and other pavement fixtures should be brought to finished grade.

The hot mix asphalt surface course consists of one or more layers placed on the previously constructed Asphalt Concrete base course. The material must be spread and compacted to the required thickness and in the grades and dimensions shown on the plans.

The finished surface must not deviate more than 1/4 inch in each direction when measured with a 10-foot straight edge.

E.1 Joints

For both longitudinal and transverse joints special attention must be paid to mix temperature, proper joint construction methods and rolling techniques to achieve proper joint density, performance and longevity. Transverse joints require reheating of the cold side of the joint to achieve proper density.

F.1 Tack Coat

If more than one lift of Asphalt Concrete is placed, the first lift should be cleaned thoroughly. If needed, a tack coat of diluted emulsified asphalt should be applied for bonding following the cleaning.

SECTION 6: PAVEMENT DESIGN FOR NON-MOTORIZED TRAILS AND PATHS

A.1 General Considerations

In addition to highways, streets, and parking lots that carry autos and trucks, many other applications for asphalt pavements exist. Sidewalks, pedestrian and bicycle trails, and paths are some common applications. Because of the unique nature of these asphalt pavement applications, a more detailed approach to their design is presented here. In many cases, the primary design consideration is a pavement structure capable of supporting occasional maintenance and emergency vehicles. Therefore, a minimum thickness to accommodate these loads may be the basis of the thickness design.

It is desirable to blend this type of pathway into the contours of the existing ground to preserve aesthetics and to reduce the impact on the natural environment. Surface drainage should flow away from these pathways wherever possible. Because of the variety of designs and applications, individual pathway widths are not listed here. For non-motorized trails and golf cart paths in particular, the size and availability of conventional road construction and maintenance equipment may determine width. Generally, a minimum width of 8 feet is recommended; a 12-foot width may be more cost effective. As a safety measure, additional widening, signage and/or striping on sharp curves is recommended. Recreation trails and walkways are usually paved to an 8-foot width to accommodate construction and maintenance operations and to provide access for emergency vehicles. It may be desirable to pave a walkway in an urban environment only 4-feet wide (or wider if significant numbers of pedestrians are present). These pavements usually are not designed to withstand repeated loads from maintenance or emergency vehicles, but an occasional heavy-load application can be made without damage.

B.1 Drainage

It is very important to keep water away from the subgrade soil. If the soil becomes saturated, it will lose strength and stability, making the overlying pavement structure susceptible to breakup under imposed loads. Both surface and subsurface drainage must be considered. All drainage must be carefully designed and should be installed as early in the construction process as practical.

Bicycle and golf cart paths should have a minimum slope of 2 percent or 1/4 inch per foot. They should be constructed in such a way that water will not collect at the pavement edge. Ideally, the finished pavement section will be higher than the adjacent grade by a minimum of 1 ½ inches. Areas of very high natural permeability may require an underdrain system to carry water away from the pavement structure.

C.1 Subgrade Preparation

Because the subgrade must serve both as the working platform to support construction equipment and as the foundation for the pavement structure, it is vital to ensure that the subgrade is properly compacted and graded. All underground utilities should be protected or relocated before grading. All drainage structures should be completed with the grading. Remove all topsoil, debris, and rocks from the areas to be paved and treat with a soil sterilant immediately ahead of the paver's laydown to inhibit future flora growth. Asphalt pavement may not be placed until the herbicide has been applied. The subgrade should be shaped properly to meet true alignment and elevation. It should be compacted to not less than 95 percent of maximum laboratory density. Proof rolling may be used on oversized (non-proctorable material) subgrade. The surface should not vary more than 3/4 inch from the established grade.

Areas that show a pronounced deflection under heavy construction traffic indicate instability in the subgrade. Such areas will likely require removal of the material and replacement with suitable subgrade material such as compacted, crushed stone or compacted, bituminous-concrete base; geotextile fabric may also be considered in conjunction with, or as a stand-alone treatment, as indicated by existing conditions. If a water seepage area is encountered, the subgrade should be drained.

C.2 Tree Root Intrusion Inhibitors

Unlike most roadway and parking lot construction, trail construction often meanders through forested or riparian areas, or near large suburban trees in boulevards. In these instances, tree root damage is the single most frequently occurring source of upheaval, cracking and general deformation of the trail surface.

To counteract this tendency in these types of heavily treed areas, the use of a tree root inhibitor must be considered and weighed in effectiveness vs cost against other alternatives. The most effective of these inhibitors has proven to be the use of medium sized rock wrapped in a geotextile fabric placed below grade such that the gravel or crushed stone subbase may continue over the top of the "burrito". The size of the rock should be in the 4" to 6" range and may be either crushed or shot rock (these are preferred) or river rock. River rock may run larger (8" top size) and should be well graded to increase compactability. The geotextile wrap must be designed to withstand the dynamics of the type of rock selected and the given soil conditions of the area of use. Additionally, it must be a non-woven fabric to inhibit the migration of fines from the surrounding soil.

The geotextile wrap material must be non-woven Class A type equal to DMS-6200 Type 1, 4.0 oz. per sq. yd. to 6.0 oz. per sq. yd.

C.3 Tree Root Barriers

In areas of trail construction that encounter individual trees, or small clusters of trees, a tree root barrier is often the best choice for protecting the long-term condition of the trail surface. There are many types and iterations of barriers available, however; the most successful and proven method and product is the use of an HDPE heavy gauge segmented and connectable panel system at least 18” in height, placed at the edge of the excavation for the trail section. The barrier must extend far enough past the future drip line of the tree(s) that it will prevent roots from following the barrier and turning into the trail section at the barrier’s end.

C.4 Soil Sterilant

Soil sterilant shall be a commercial grade trifluralin (TREFLAN) at a rate of 11 fluid ounces. per 1,000 sq. ft. or dichlobenil (CASORON 4G) at a rate of 6 lbs. per 1,000 sq. ft. on dry sites and aquatically labeled imazapyr (Habitat) 1.1 fluid ounces per 1000 square feet on wet or aquatic sites. Pave shortly after application, with a maximum exposure time of 6 hours.

D.1 Asphalt Concrete Pavements - Trails

Non-motorized commuter trails, recreational trails, paths and sidewalks may be constructed in one course or with a separate asphalt base and surface course. Minimum lift thickness should be at least 3 times the nominal maximum aggregate size to ensure aggregate can align themselves during compaction to achieve required density and also to ensure mix is impermeable.

The Asphalt Concrete base course should be placed directly on the prepared subgrade in one lift in a thickness of 3 inches or less, and spread and compacted. Compaction is one of the most important construction operations in terms of its contribution to the performance of the completed pavement.

Aggregate base should be placed on the prepared subgrade and compacted to ensure a hard, uniform, well-compacted surface.

The asphalt concrete and aggregate base course should be placed to the true line and grade. Any irregularities in the aggregate base’s surface should be corrected prior to placement of the asphalt concrete. Any irregularities in the asphalt concrete surface should be corrected immediately behind the paver and before rolling. As soon as the material can be compacted without displacement, rolling and compaction should be started and should continue until the surface is thoroughly compacted and all roller marks have disappeared.

If a second lift of asphalt concrete is to be placed, the previous course should be clean. If necessary, a tack coat of diluted emulsified asphalt may require application after cleaning.

D.2 Thickness Table - Paths, Trails and Walkways

The pavement thickness for **Paths, Trails and Walkways** should be in accordance with the following table:

Design Criteria*			Thickness in Inches		
Traffic Class	Subgrade		Aggregate Base Course	Asphalt Concrete	Total
	Class	CBR			
I (Bicycles and occasional light maintenance vehicles)	Good	9	4.0	2.5	6.5
	Moderate	6	4.0	3.0	7.0
	Poor	3	6.0	3.0	9.0

*See Section 1 SOIL SUPPORT section for traffic and soil classification details.

References: Asphalt Paving Association of Iowa

E.1 Asphalt Seal Coat

The use of a properly constructed seal coat can be very beneficial to extending the life of parking lots (1/4” gradation aggregate “chip seal”) and especially trails (sand gradation aggregate) when used appropriately for the condition of the pavement being treated. No fog seals or “driveway” type seal coats with only minus 200 mineral filler are acceptable. Maintaining surface friction is of paramount consideration when constructing trail pavement seal coats.

SECTION 7: CONSTRUCTION PRACTICES – TRAILS & PATHS

A.1 Subgrade Preparation

All vegetation (including root systems), rocks, debris and topsoil shall be removed from the area to be paved. To prevent future growth, the subgrade should be treated with an approved soil sterilant. Install drainage and utility facilities and then backfill and compact. Adjustments in utilities or underground facilities cover can be readily accomplished through the asphalt base should changes occur.

The subgrade must be properly shaped to meet true lines and elevations. It must be compacted to not less than 95 percent of maximum laboratory proctor density defined in ASTM D698. Proof rolling may be used on oversized (non-proctorable material) subgrade. The surface of the compacted subgrade must not deviate by more than 3/4” from the established grade. A maximum cross slope of less than or equal to 2 percent or 1/4” per foot should be maintained to provide adequate drainage of surface water from the finished pavement and meet ADA requirements. Running grades must comply with AASHTO guidelines and ADA requirements.

Areas that show pronounced deflection under construction traffic indicate instability in the subgrade. If reworking and additional rolling do not correct the situation, the area soil must be removed, replaced with suitable material and re-compacted. The use of asphalt-treated base or coarse granular material is recommended. Imported fill must meet the following gradation:

TABLE OF GRADATIONS		
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE		
Sieve Opening	Percentage Passing	Tolerance
3-inch	100	
No. 4 Sieve	25 - 60	
No. 200 Sieve	15	Maximum

Where subgrade soils contain greater than 15% passing a No.200 Sieve, a geotextile separation fabric is recommended to be placed on the subgrade prior to base layer placement.

Once compaction operations are complete, proof roll the subgrade with a fully loaded 10-yard dump truck or a fully loaded 4,000 gallon water truck to identify soft or unstable areas.

A.2 Aggregate Base Course

Aggregate base course material consists of a combination of both fine and course fragments of crushed stone, crushed gravel or natural gravel blended with sand, finely crushed stone, recycled concrete or asphalt. Crushed stone or gravel must be hard and durable free from flat, elongated, soft or disintegrated pieces, soil or other deleterious material. At least 35% of material retained on the No. 4 Sieve must have at least one fractured face.

Aggregate base course must meet the following gradation:

TABLE OF GRADATIONS		
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE		
Sieve Opening	Percentage Passing	Tolerance
¾-inch Sieve	100	
No. 4 Sieve	40 - 70	
No. 10 Sieve	25 - 55	
No. 200 Sieve	2 - 10	Maximum 40% of portion passing No. 40 Sieve, plasticity index 6 or less per AASHTO T89 and T90

B.1 Asphalt Mix Design

All asphalt mix designs require an engineer's stamp.

Mix design for trails shall be a Type C, 35 blow Marshall mix, consistent with the MS-2 Asphalt Mix Design Methods, 7th Edition, including the following:

TYPE C MIX PARAMETERS		
Test Parameter	Test Target	Tolerance
Laboratory Mix Design Voids Content	3% Max	
Field Marshall Voids Content	4%	+/- 1%
Percent Asphalt	Per Mix Design	+/- 0.4%
Flow in 0.01"	14	-6 to +4
VMA at 0.5" particle	14 Min	

Bituminous oil for the Type C asphalt mix shall be PG 58-28, unless otherwise specified by the engineer.

Mix design for parking lots shall be a Type B, 50 blow Marshall mix, consistent with the MS-2 Asphalt Mix Design Methods, 7th Edition, including the following:

TYPE B MIX PARAMETERS		
Test Parameter	Test Target	Tolerance
Laboratory Mix Design Voids Content	3%	+/- 1%
Field Marshall Voids Content	4%	+/- 1%
Percent Asphalt	Per Mix Design	+/- 0.8%
Flow in 0.01"	14	-6 to +4
VMA at 0.5" particle	14	+/- 1

Bituminous oil for the Type B asphalt mix shall be PG 64-28, unless otherwise specified by the engineer.

Surface course asphalt plant mix aggregate must meet the following gradation:

TABLE OF MIX GRADATIONS				
REQUIREMENTS FOR GRADING OF SURFACE COURSE AGGREGATE				
Sieve Opening	Type B Percentage Passing	Job Mix Tolerance	Type C Percentage Passing	Job Mix Tolerance
¾-inch Sieve	100			
½-inch Sieve	83 – 93	+/- 7	100	
3/8-inch Sieve	73 – 87	+/- 7	91 – 93	+/- 7
No. 4 Sieve	47 – 63	+/- 6	51 – 71	+/- 6
No. 10 Sieve	32 – 43	+/- 6	34 – 46	+/- 6
No. 40 Sieve	15 – 25	+/- 5	16 – 26	+/- 5

TABLE OF MIX GRADATIONS				
REQUIREMENTS FOR GRADING OF SURFACE COURSE AGGREGATE				
Sieve Opening	Type B Percentage Passing	Job Mix Tolerance	Type C Percentage Passing	Job Mix Tolerance
No. 200 Sieve	5 – 7	+/- 2	5 - 9	+/- 2

The above gradation bands represent the job mix target limits, which determine the suitability of aggregate for use. The final job mix target gradation must be within the specified bands and uniformly graded from coarse to fine and not vary from the low limits on one screen to the high limits on the adjacent screen, or vice versa. The final job mix gradation limits are established by applying the job mix tolerances to the job mix targets.

The job mix formula establishes target values. During production of the mix, the gradations shall lie within the job mix gradation limits specified in Table of Mix Gradations. For example, “The Type B mix, No. 200 band is ‘5-7’ percent. A Quality Assurance job mix target of 5 has been selected for the final mix. The job mix gradation limits is 5, plus and minus 2. Therefore, the job mix gradation limits for production is 3-7percent.”

B.2 Acceptable Reclaimed Asphalt Pavement Percentages

Reclaimed Asphalt Pavement (RAP) may be included in pathway and parking lot asphalt mixes with the concurrence of the owner’s representative. Unless otherwise approved, the maximum allowable RAP content of pathway and parking lot asphalt mix is 20%. When RAP is approved, the following fractionations must be met:

- 20% RAP – ¾” particles or less.
- 30% RAP – ½” particles or less.
- All RAP must meet the gradation in the Table of Mix Gradations.

When 20 percent or less RAP is used in a mix, a drop in one asphalt grade (softer bituminous oil) may be required. For mixes with greater than 20 percent RAP, a minimum drop in one asphalt grade is required to compensate for the greater viscosity of the oxidized binder. The engineer approving the design mix must determine the required asphalt grade drop for all mixes incorporating RAP.

C.1 Asphalt Lift Thickness

Nominal aggregate size dictates lift thickness. Minimum lift thickness should be at least 3 times the nominal maximum aggregate size to ensure aggregate can be aligned during compaction to achieve required density and also to ensure mix is impermeable. Therefore, the desired lift thickness can direct the decision on nominal aggregate size to use.

The maximum lift thickness is dependent also upon the type of compaction equipment that is being used. When static steel-wheeled rollers are used, the maximum lift thickness that can be properly compacted is 3 inches. When pneumatic or vibratory rollers are used, the maximum

thickness of lift that can be compacted is almost unlimited. Generally, lift thicknesses are limited to 6" or 8". Proper placement becomes a problem in lifts thicker than 6" or 8".

D.1 Surface Course Construction

The hot mix asphalt surface course may consist of one or more layers placed on the previously constructed base course. The material must be uniformly spread and compacted to the required thickness and in the grades and dimensions shown on the plans. Extra care must be exercised to ensure a tight and uniformly textured asphalt mat surface. No segregated material "rock pockets" or deformations caused by inadequate temperature or dragging by the screed will be acceptable. Additionally, stop and start bumps caused by the screed sitting stationary too long must be addressed and removed immediately upon restart and no "auger shadows" may be present in the finished pavement surface. Proper attention to paver setup is key to effectively eliminate these deformations and constant "looking back" and addressing surface irregularities must be standard practice. The finished surface must not deviate more than 1/4" when measured with a 10-foot straight edge in any direction. Additionally, the finished surface cross slope shall not exceed 2% or 1/4" per foot per ADA requirements.

E.1 Joints

For both longitudinal and transverse joints special attention must be paid to mix temperature, proper joint construction methods and rolling techniques to achieve proper performance and longevity. Paving that must stop and restart after the asphalt has cooled below minimum temperature requires vertical saw cutting of the pavement, removal, cleaning and tack coating of the remaining asphalt to ensure a properly constructed "cold joint" that is both uniform and equally compacted as the adjoining material.

F.1 Tack Coat

If more than one lift of Asphalt Concrete is placed, the prior placed lift should be cleaned thoroughly. If needed, a tack coat of diluted emulsified asphalt should be applied for bonding following the cleaning.

SECTION 8: INSPECTION

In addition to those inspection activities called out in the general and special conditions, conduct inspection activities at all stages of construction, including:

1. Subgrade Compaction. The subgrade must be compacted to not less than 95 percent of maximum laboratory density. Proof rolling the subgrade with a fully loaded 10-yard dump truck or a fully loaded 4,000 gallon water truck to identify soft or unstable areas where the subgrade includes large, non-proctorable material is acceptable. Conduct one nuclear compaction test per 200 lineal feet of trail for each lift placed.
2. Aggregate Base Course Compaction. Conduct one nuclear compaction test per 200 lineal feet of trail for each lift placed.
3. Hopper/Screed Auger. Inspect hopper and screed auger function to ensure adequate transport of hot asphalt mix without segregation of mix particles. Verify that the auger speeds match the paver speed.
4. Screed Setting. Inspect the screed setting to ensure satisfactory placement of hot asphalt

mix without variations in mat height, without segregation of mix particles and without tearing the mat. Verify that the screed setting matches the paver speed.

5. Knock-down Roll. Inspect the initial knock-down roll for consistent compaction. Check for stretching, uneven mat thickness or roller marks. Adjust knock-down rolling procedures if defects are noted.
6. Compaction. Conduct one nuclear density test per 100 lineal feet. Collect a minimum of one Marshall Lab specimen from each day's operation. Obtain a minimum of 3 core samples for density and thickness for each day's production up to ½ mile of trail.

SECTION 9: MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS (MPWSS) SUPPLEMENTARY SPECIFICATIONS AND CONDITIONS

The most current edition of MPWSS shall be used for all City of Missoula Parks & Recreation projects as revised/modified here-in. Engineer or project designer shall incorporate the following modifications or revisions as noted below. Where these revisions/modifications may conflict with other specifications or requirements, these revisions/modifications shall take precedence.

MPWSS - Section 02510 Asphalt Concrete Pavement

Part 2 Products, 2.2 Plant Mix Aggregates

Sub-part F. - Following the first sentence, insert “Fine aggregate angularity shall achieve a minimum of 40% according to AASHTO T304, Method A. Maximum percentage of natural fines of 20%.”

Sub-part G. - Delete the first sentence following “by weight of particles” and insert “having a minimum fracture of 75%.”

Sub-part I. Surface Course Asphalt Plant Mix Aggregate: - Insert “Parks Roadway and Parking lot pavements may be constructed of a combination of both Type A and Type B mixes as indicated by designed use requirements. Trails shall be constructed of a single lift of Type C mix, or may be constructed of a base lift of Type B mix overlaid with a Type C mix where indicated by design or use conditions.”

Part 2, 2.5 Composition of Mixes

Subpart A. General:

1. Modify as follows: Add: “Mix Design Requirements – independent laboratory, certified by licensed engineer.” Add: “Mix design submittal checklist is required.”; Add: “Warm mix” asphalt design is allowed and encouraged for appropriate pavement use.”
3. d. Modify as follows: Add: “Incorporate other Marshall Mix design criteria according Asphalt Institute MS-2 (current edition) including: Stability, Flow, Voids, Voids in the Mineral Aggregate and Voids Filled with Asphalt.”; Add: “Target void range shall be 2-3% for trails and 3-5% for parking lots.”
3. f. Modify as follows: Add: “RAP shall be allowed to 20%, per approved mix design method. Percentage may be increased only by preapproval of owner/engineer.”
3. h. Modify as follows: Add: “Use 50 blow Marshall for high use parking lots and roadways, use 35 blow Marshall for low use parking lots and trails.”
3. j. Modify as follows: Add: “The Modified Lottman is required for mix moisture-sensitivity testing during production when anti-strip or lime is required in the mix to mitigate retained strength loss. This may be done by owner/engineer at their option.”

Subpart B. Asphalt Concrete Surface Course:

2. a. Modify as follows: Insert following “specimen’: 35 or 50 blows depending upon surface course usage as indicated in A.3.h.”; delete: ...”50.”
2. d. Modify as follows: Following “percent....” Delete “3-5” and insert “2-3 for trails and 3-5 for parking lots.”
2. e. Modify as follows: “Where Table 4 values differ from the Asphalt Institute MS-2 (current edition) Marshall Mix design criteria, the A.I. MS-2 values shall take precedence.”

Part 3 Execution

Subpart 3.12 New Work:

B. Modify as follows: Following the last sentence, Add: “Prior to scheduling a paving operation, the Contractor shall submit a paving plan to the owner for approval.”

Subpart 3.9 Sampling and Testing for Acceptance:

A. Modify as follows: In the third sentence, Delete, “beginning with ‘core testing~’” and replace with: “mix samples and densities (both mat and joints).”

Subpart 3.16 Spreading and Finishing:

A.1. Modify as follows: Add: “The maximum finished lift thickness for trail surface courses shall be 3”.”

Subpart 3.17 Mechanical Pavers:

E. Modify as follows: Following the last sentence, Add: “To determine the acceptability of spread material, the meaning of the terms uniformity of surface and segregation of materials are defined as follows: Surface uniformity shall mean that the spread material surface shall be free of any noticeable variance in the texture and regularity of the material as compared to any other adjacent or nearby material. Segregation of materials shall be defined as a noticeable variation in the composition of the material in any given area of the pavement as compared to adjacent or nearby material. Any pavement demonstrating these unacceptable characteristics requires immediate stoppage of the pavement operation and must be immediately corrected to acceptable standards before continuing. Pavement that cannot be corrected must be removed and replaced before continuing with the paving operation. Rolling of such material and continuing of the paving operation shall constitute a rejection of any subsequently placed pavement.”

Subpart 3.23 Edges:

A. Modify as follows: Following the first sentence, Add: “Immediately following, or prior to, edge surface rolling, trim and compact the outside edge to a 2:1 slope ensuring a straight and stable edge that is parallel with the centerline of the pavement section. Trimming may be performed mechanically, or with an asphalt lute or rake; compaction may be performed mechanically, either within, or directly behind, the paver’s end gates or may be hand-tamped achieving a finished 2:1 sloped edge. Irregular or vertical and uncompacted edges are causes for rejection.”

Subpart 3.29 Pavement and Material Testing Requirements:

B. Modify as follows: Add: “Investigation of deficiencies shall be by random selection, with multiple samples taken by independent lab.

Acceptance may, at the owner’s/engineer’s discretion, be by price reduction for density and mix volumetric & AC% deviations. The Highway Department’s basis, when possible, shall be used for reduction calculation.

Quality assurance mix testing frequency shall be based on a daily or tonnage basis, owner’s/engineer’s option.”

PART 5 – PARK FACILITY DESIGN CRITERIA

SECTION 1: INTRODUCTION

When designing park facilities, the landscape architect must consider costs of construction and maintenance in relation to the benefit derived by the community. Proper design and effective use of the built environment can lead to a happy and healthy community, as well as plant and animal diversity within the community. Section 2 covers natural material trail specifications. Section 3 covers lighting specifications. Section 4 covers imported topsoil requirements. Section 5 covers turf grass specifications consistent with the Turf Management Plan. Section 6 covers signage and bollard requirements. Section 7 covers graffiti protection requirements.

SECTION 2: NATURAL GRAVEL TRAILS

NON-STABILIZED TRAILS

Non-stabilized trail work is the placing of one or more non-stabilized base courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein. See Detail PR-122-1 for non-stabilized trail installation.

Crushed Base Material: Reference and incorporate the following requirements when designing a non-stabilized trail.

- Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings, recycled concrete and/or asphalt or other similar materials.
- Use crushed stone or crushed gravel consisting of hard, durable particles of fragments of stone, free of excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear of not exceeding 50 at 500 revolutions when tested under AASHTO T96.
- Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 35 percent of the material retained on the No. 4 sieve has at least one fractured face.
- Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

Gradation: Aggregate base must meet the following specific requirements.

- As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

Table 8. Non-stabilized Trail Gradations

TABLE OF GRADATIONS	
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE Passing ¾" Minus	
¾ Inch	100
½ Inch	–
No. 4 Sieve	40-70
No. 10 Sieve	25-55
No. 200 Sieve	2-10

- The produced material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.
- Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.
- The portion of the fine aggregate passing the No. 200 sieve must be less than 60 percent of the portion passing the No. 40 sieve.
- The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

Underlayment Materials: When required for specific sites, filter fabric underlayment must be non-woven Class A type equal to DMS-6200 Type 1, 4.0 oz. per sq. yd. to 6.0 oz. per sq. yd.

Watering: When watering crushed base material, use uncontaminated water.

STABILIZED TRAILS

For Stabilized trails, add the following materials and steps to the process listed for non-stabilized trails. See Detail PR-122-2 for stabilized trail installation.

Gradation: Decomposed granite aggregate must meet the following specific requirements.

- As determined by AASHTO Methods T11-82 and T27-82, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

Table 9. Stabilized Trail Gradations

TABLE OF GRADATIONS	
PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE Passing 3/8" Minus	
3/8 Inch	100
No. 4 Sieve	95-100
No. 8 Sieve	75-80
No. 16 Sieve	55-65
No. 30 Sieve	40-50
No. 10 Sieve	25-55
No. 50 Sieve	25-35
No. 100 Sieve	20-25
No. 200 Sieve	2-10

Stabilizing Material: The solidifying emulsion must be either a water-based polymer or a powder based product. In addition, it must be non-toxic, colorless and odorless and, be organic in nature. The binder/solidifying emulsion must not alter the color of the decomposed granite.

- Use psyllium Stabilizer manufactured by Stabilizer Solutions, Inc., or approved equal.
- One ton of Stabilized aggregate on average covers 65 sq. ft. at a 3" depth. Coverage will vary depending on aggregate.

When required for specific sites, filter fabric underlayment must be non-woven Class A type equal to DMS-6200 Type 1, 4.0 oz. per sq. yd. to 6.0 oz. per sq. yd.

Watering: When watering stabilized base material, use uncontaminated water.

SECTION 3: PARK AND TRAIL LIGHTING DESIGN STANDARDS

The work covered in this section involves the design, purchase and installation of park and trail lighting. These standards provide the tools needed to understand the design goals of Missoula Parks and Recreation for lighting pedestrian trails.

The following have been identified as most important regarding lighting design:

- Create design that enhances the pedestrian experience
- Provide safety and security for the people using the trails and parks
- Create design that reflects Missoula's history
- Use of efficient lighting technologies
- Provide lighting design that meets the Dark Skies Initiative, as well as meets the Missoula Lighting Ordinance
- Ease of maintenance and vandal resistance
- Exercise fiscal responsibility

DESIGN CONSIDERATIONS

Lighting Levels: Lighting levels on the trail system shall create a safe and secure environment. Lighting levels shall be in conformance with the levels recommended by the Illuminating Engineering Society of North America (IESNA) as follows:

- Trail lighting: 0.6 foot candles average with a 3.0:1 average to minimum ratio. Spacing the Missoula Parks and Recreation standard LED luminaries/poles between 90' and 120' on center will achieve the desired lighting levels.
- Building entrances: 5.0 foot candles minimum.
- The project engineer shall calculate the lighting levels using a computer-aided program that produces a point-by-point photometric calculation to ensure the proper lighting level is achieved. A light loss factor of 0.9 shall be utilized for all LED lighting calculations.

Impact on Night Sky (Dark Skies Initiative): All new lighting must comply with the current Dark Skies Initiative and with the Missoula Lighting Ordinance. Furthermore, the designer shall endeavor to reduce the amount of reflected

Types of Conditions: The following trail conditions must be considered during the lighting design process.

- Pedestrian trails
- Trail intersections
- Trails next to buildings
- Crosswalks
- Bridges
- Wayfinding and interpretive illumination

Power: The power source for the trail lighting system shall be 240 volts single phase. Where possible, the power supply for new trail lighting shall be an extension of the existing trail lighting circuit. The project engineer shall conduct a load study to determine the available spare capacity of the existing lighting circuit to determine the available spare capacity.

Where the existing circuits are not adequate to supply the new lighting, a new electrical service shall be installed. The service equipment consists of a Tescoflex, or approved equal, as shown in Detail PR-119.

MATERIALS

Luminaries and Poles: The following luminaire and pole have been approved by Missoula Parks and Recreation. **No substitutions.** See Detail PR-123 for luminaire installation.

- Luminaire: Hadco #9550
- Arm: Hadco #CP2542A

- Pole: Hadco #CA2542
- Color: Verde Green
- Photoelectric Control: Intermatic #K4436sM or Tork #2115
- Time Clock: Intermatic #ET1105C or Tork #E120B

Bases: All lighting poles shall be mounted to a reinforced concrete pole bases as shown in Detail PR-123. Top of pole base shall be set flush with grade and include a concrete mow strip around the perimeter of the base. Poles shall be located to maintain 24” of clearance from the pole to the edge of the trail as required to conform with bike trail safety standards. Exact location shall be coordinated with the existing utilities and trail easements.

Conduit and wire: Wiring for all lighting circuits shall be copper conductors concealed in conduit. Minimum wire size shall be #8 to limit voltage drop to an acceptable level and allow for future additions. All underground conduits shall be Schedule 40 PVC conduit, and all above grade exposed conduit shall be rigid steel. Conduit inside of a building is allowed to be EMT conduit where not subject to physical damage. The minimum size for underground conduit feeding trail lighting poles shall be 1-½” Schedule 40 PVC. Underground conduit shall have a minimum cover of 30”.

Direct burial cable is not allowed.

Trenches for underground conduit shall be coordinated with existing utilities and landscape. Adjust location of the trench as required to avoid conflict. Locate conduit trenches outside of existing tree drip line. Where it is not possible to locate outside the drip line, the conduit shall be bored under the tree roots. Conduit bore shall be a minimum of 42” deep.

The project engineer shall conduct voltage drop calculations for all lighting circuits. Limit the voltage drop in all circuits to 3% of the nominal voltage rating.

Controls: The trail lighting shall be turned on at dusk and off at dawn with a single photoelectric control located at the power source. Photoelectric control devices mounted on each pole or luminaire are not allowed. A bypass switch shall be installed at each photoelectric control device to allow the photo cell to be bypassed for manually turning on the lighting for testing. Lighting controls shall also include a time clock to allow the trail lighting to be turned off late at night or early morning to conserve energy.

Central control systems or dedicated controllers for pathway and field lighting may be considered on larger park sites. Contact the PTDDM to discuss the use of central control systems for lighting control. Connecting lighting controls to an irrigation controller is not allowed.

All lighting control panels shall have a laminated control diagram attached to the inside of the panel. Control diagram shall identify circuit numbers and a list of the pole identification numbers that are powered by each circuit. Refer to Detail PR-124 for additional lighting control information.

Construction Documents shall include, but not limited to, the following:

- Proposed Lighting: All luminaires shall be graphically located on the plans including all light standards, fixtures, pull boxes, transformers and other construction components.
- Point of Connection: The electrical utility service point shall be shown on the plans. If the point of connection is not within the project site, the service point shall be identified in a vicinity map detail. **Any fees associated with the connection to the utility shall be enumerated by an appropriate bid item.**
- Light Fixture Legend: Shall include symbols for luminaires, poles, fixture types, conduit size, panels and utility service points.
- Lighting Fixtures Schedule: Shall identify the fixture type as shown on the plans, the manufacturer and model number, lamp type and wattage, voltage required and any notes that pertain specifically to each fixture type.
- Panel Schedule: Shall designate circuits with the number of devices being served, voltage, number of phases, short circuit rating, load continues amperage, etc.
- Lighting Details: Shall be provided within construction documents to further define special construction details pertaining to the lighting equipment and construction and so that contractors can provide “apples to apples” competitive bids.
- Lighting Specifications: Shall be provided on the plans or provided in a specification book, which conforms to the standards set forth within this design guide as a whole. Specifications must include at a minimum, everything included in the Light Fixture Schedule, plus fixture cut-sheets for each luminaire, standard and lamp used.

SECTION 4: IMPORTED TOPSOIL REQUIREMENTS

Where imported topsoil is called out in the specifications or on the plans, the following requirements apply to the imported topsoil:

- Soil sample testing is required for all imported topsoil used on projects covered under this manual.
 - Composite soil sample testing is acceptable when proposed topsoil is stockpiled.
 - Individual composite soil samples are required when proposed topsoil is in situ at the import source site. Where proposed topsoil is in situ, one composite sample will be required per 2 acres of surface area. The composite sample will be composed of several randomly selected soil grabs within the 2 acre site. Collect soil samples 6” below surface grade.
- Acceptable imported topsoil nutrient levels fall within the ranges specified in Table 8. For soils falling outside of the acceptable ranges, contact the owner’s representative for further instructions.
- Acceptable imported topsoil textures fall within the ranges specified in Table 9.
- The maximum rock size is 1”.

Missoula Parks and Recreation Design Manual Acceptable Soil Nutrient Levels for Landscape Soils		
Soil Element	Unit of Measure	Acceptable Ranges
Ammonia (NH ₃ -N)	ppm	10-50 ppm
Nitrate (NO ₃ -N)	ppm	20-100 ppm
Total Available N	ppm	75-150 ppm
Phosphorus (P ₂ O ₅)	ppm	100-300 ppm
Potassium (K ₂ O)	meq/l	450-750 meq/l
Calcium (Ca)	meq/l	2861-3576 meq/l
Magnesium (Mg)	meq/l	300-600 meq/l
Sulfate (SO ₄ -S)	meq/l	100-200 meq/l
Sodium (Na)	meq/l	<250 meq/l
Chloride (Cl)	meq/l	1-100 meq/l
E _c e (dS/m)	dS/m	0.2-4 dS/m
Copper (Cu)	ppm	1+ ppm
Zinc (Zn)	ppm	2+ ppm
Iron (Fe)	ppm	8+ ppm
Manganese (Mn)	ppm	3+ ppm
Boron (B)	ppm	1-4 ppm
SAR	ratio	0-6
CEC	meq/100gms	10-20 meq/100 grams
ESP	%	0-10
pH Value		6.5-7.5
Organic Matter	%	5%-10% landscape, 10%-20% turf

Table 10. Acceptable Soil Parameters

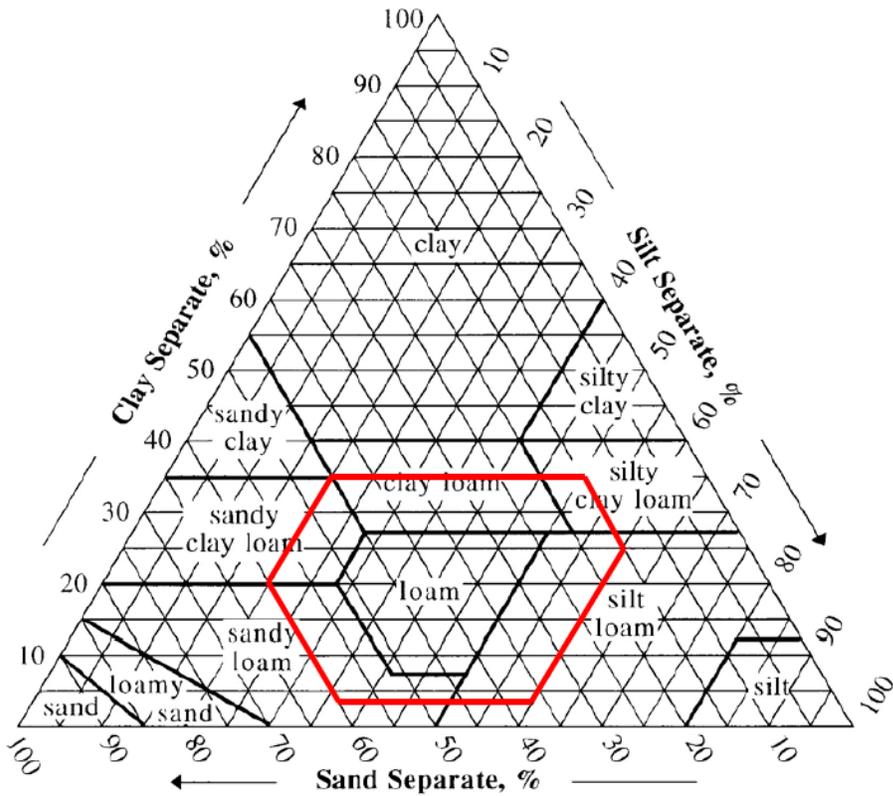


Table 11. Acceptable soil textures

Imported topsoil must be accepted prior to delivery to the site. Soil delivered to the site prior to testing and acceptance will be rejected.

SECTION 5: TURF DESIGN STANDARDS

The work covered in this section involves the design and installation of turf grasses in parks, landscape parcels and greenways. These standards provide the tools needed to understand the design goals of Missoula Parks and Recreation turf grass installations.

The following have been identified as most important criteria regarding turf grass design:

- Create design that enhances the public experience
- Provide an exceptional playing surface for active sports
- Use the appropriate turf grass for the site
- Ease of maintenance
- Exercise fiscal responsibility

The landscape architect, in concert with the Developed Parks Manager, will determine specific turf species and cultivars for specific sites.

DESIGN CONSIDERATIONS

Yearly Precipitation: The average yearly precipitation for Missoula is 14.7”, with the majority of the precipitation falling in the months of May and June. Of the Summer months, July is the driest.

Yearly Evapotranspiration: The 10-year average reference evapotranspiration rate (ET_r) for Missoula is 38” using turf grass as the reference. Daily ET_r rates increase from an average of 0.1” of precipitation need in mid-April to the maximum average of 0.32” inches of precipitation need in mid-July. From mid-July, the daily ET_r rates gradually taper off to 0.1” precipitation need in mid-October. Non-irrigated grasses must be adapted to these precipitation patterns.

Yearly ET requirements must be considered when selecting grasses for a specific site and use.

Weed Seeds: The maximum weed seed percentage allow for Missoula applications is 1.0% by weight. Weed seeds in a turf grass mix include Dandelion, Ox-eye Daisy, Black Medic, Kochia, Knotweed, Plantain, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, Brome Grass, Black Henbane, Buffalobur, Common Crupina, Dalmatian Toadflax, Diffuse Knapweed, Dyer’s Woad, Field Bindweed, Hoary Cress, Joined Goatgrass, Leafy Spurge, Matgrass, Meadow Hawkweed, Meadow Knapweed, Milium, Musk Thistle, Orange Hawkweed, Perennial Pepperweed, Perennial Sowthistle, Poison Hemlock, Puncturevine, Purple Loosestrife, Russian Knapweed, Scotch Broom, Scotch Thistle, Silverleaf Nightshade, Skeletonleaf Bursage, Spotted Knapweed, Syrian Beancaper, Toothed Spurge, Yellow Starthistle, Yellow Toadflax.

Grass Seed Selection: When calling out the proposed grass seed selection, the landscape architect must identify the proposed grass seed mixture including the botanical and common name and

percentage by weight of each species and variety, percentage of purity, expected percentage of germination and maximum allowable percentage of weed seed. Include the year of production and date of packaging.

Certification of Grass Seed: Grass seed shall be weed free, fresh, re-cleaned, Grade A, new crop consisting of the percentages of mix as specified. Prior to purchasing grass seed, the contractor must obtain certification from the supplier identifying the monostand or mixture including the botanical and common name and percentage by weight of each species and variety, percentage of purity, tested percentage of germination, and verified percentage of weed seed. The certification must also include the year of production and date of packaging.

Grass Seed Mixtures: Missoula has a number of micro-climates with the city requiring the use of different grasses. Consistent with these micro-climates and the Turf Management Plan, the landscape architect must identify which grass species and specific cultivar will be used on the project site and the rate of application per acre. The following seed mixtures identify the minimum percentages of each grass species for specific use areas.

Missoula Park Turf Mixes			
Site	Grass Species	Percentage	Comments
General Lawn	Fescue	60%	
	Bluegrass	40%	
Sports Turf	Fescue	30%	
	Bluegrass	70%	
Dog Park	Fescue	60%	
	Bluegrass	40%	
Seasonally Mowed	Red Fescue	45%	
	Hard Fescue	30%	
	Sheeps Fescue	25%	
Bioswales	Native Grass Blend	66.4%	See Appendix "E" for native grass mix
	Gaillardia	16.9%	
	Achillea	16.9%	
Dry Sites	Dry Grass Mix		See Appendix "E" for dry grass mix
Native Sites	Native Grass Mix		See Appendix "E" for native grass mix

Table 12. Missoula turf mixes

APPLICATION

There are three acceptable application methods for seeding including broadcast seeding, hydroseeding and drill seeding. The landscape architect must determine the appropriate application method for the specific area on the site.

- **Broadcast Seeding:** Seed must be applied at the specified rate and lightly scarified into the

soil.

- Drill Seeding: Seed must be applied at the specified rate using a seed drill with drills spaced 6” to 8” apart. Where supplemental water will be applied, no cover material is required. Where no supplemental water will be applied, apply a cover slurry at a rate of 900 lbs of fiber per acre.
- Hydromulch: When hydromulching, seed must be applied in a slurry at a rate of 1,800 lbs of fiber per acre.

SECTION 6: SIGNAGE AND BOLLARDS

The work covered in this section involves the design and installation of signage and bollards in parks, landscape parcels and greenways. These standards provide the tools needed to understand the design goals of Missoula Parks and Recreation signage and bollard installations.

WAYFINDING BOLLARDS

Wayfinding bollards along trails serve 3 purposes. First, they identify the specific trail or trail segment within the trail system. Second, the bollards identify the mileage along the trail or trail segment. And most important, the bollards contain a unique identification number identifying a specific location for 911 dispatchers. This identification number allows first responders to pinpoint the exact location of a call, shaving precious minutes from their response time.

For the Milwaukee and Bitterroot Trails, the “Zero” mile marker located in the circle bed just West of Hickory Street and just South of Wyoming Avenue. Marker “1000” is at the intersection of Bitterroot and Milwaukee Trails. Milwaukee Trail numbers are in the 1000’s with odd numbers running to the West and even numbers running to the East. The Bitterroot Trail numbers are in the 2000’s with odd numbers running to the South and even numbers running to the North.

For Ron’s River Trail, the “Zero” mile marker is located at the Ron MacDonald kiosk in Caras Park near the restrooms. Ron’s River Trail (entire commuter route, generally adjacent to Clark Fork River AND on north side of Clark Fork River) numbers are in the 3000’s with odds running West and evens running to the East.

- Even numbers go East or North from “start”
- Odd numbers go West or South from “start”

Note: Anything that follows the abandoned Milwaukee Road right-of-way **IS** the Milwaukee Trail. There are sections of the Milwaukee Trail through Kim Williams Nature Area referred to as the Kim Williams Trail. However, this is the Milwaukee Trail.

The requirements for bollards are shown in Detail PR-125.

SECTION 7: GRAFFITI PROTECTION

All building walls, site walls, and concrete amenities such as tables, benches, drinking fountains, etc. shall be treated with a non-sacrificial anti-graffiti material. Anti-graffiti coating shall be Aquaseal ME12 (Item 5200), Permashield Base (Item 6100) and Permashield Premium (Item 5600 for matte finish or Item 5650 for gloss finish) as manufactured by Monopole Inc.

See Appendix C for anti-graffiti material application.

APPENDIX A

City of Missoula SAMPLE MAINTENANCE PERFORMANCE SPECIFICATION

RUSSELL STREET MEDIAN ISLANDS AND PATHWAYS

prepared by:

CHARLES DARWIN AND ASSOCIATES
BILLINGS, MT

Landscape Level of Service: Level 6
Hardscape Level of Service: Level 3
Pathway Level of Service: Level 4

Russell Street Median Islands and Sidewalks – Broadway to Dakota Street.

Landscape Components:

1. Median island trees, shrubs and ground covers (23,560 sq ft)
2. Tree Wells (60 trees, 1,500 sq ft)
3. Irrigation (25,060 sq ft)
4. Garbage Cans (10 cans)
5. Mutt Mitt Stations (4 stations)
6. Median bullnoses, access strips and pedestrian refuges
7. Pathway access ramps
8. Bridge Pathways

Landscape Maintenance Schedule:

Weekly service including the following:

1. Weekly trash, litter and debris removal
2. Weekly landscape maintenance and weed control
3. Weekly visual check for damage or vandalism
4. Weekly irrigation checks and maintenance

Monthly service including the following:

1. Monitor and apply weed control on a monthly basis
2. Monitor for aphids May through October, treat as needed
3. Remove suckers and water sprouts from trees

Yearly service including the following:

1. Yearly soil pre-emergent application
2. Apply fertilizer in mid-May using a Sulfur Coated Urea (SCU)

Irrigation Schedule:

1. Water based upon the Agrimet Reference Evapotranspiration (ET_r) curve for Missoula at

38 inches per year and an ET crop coefficient (ETc) of 0.80.

Hardscape Maintenance Schedule

Monthly service including the following:

1. Clean pedestrian refuges

Yearly service including the following:

1. Yearly soil pre-emergent application
2. Clean refuges of roadway sand

Pathway Maintenance Schedule

Weekly service including the following:

1. Weekly trash can service, litter and debris removal
2. Weekly visual check for damage or vandalism

Monthly service including the following:

1. Monitor and apply weed control on a monthly basis
2. Edge mowing
3. Monthly lighting check
4. Monthly pathway sweeping
5. Monthly bridge pedestrian pathway sweeping

Yearly service including the following:

1. Yearly soil pre-emergent application
2. Winter snow removal

APPENDIX B

**City of Missoula
MAINTENANCE IMPACT STATEMENT – SAMPLE**

Owner	Facility	Maintenance Responsibility	Median Islands	Tree Wells	Garbage Cans & Mutt Mitts	Irrigation	Pathways	Pathways	Pathway Ramp Shoulders
City	Russell St Medians	G&H	23560	60	10 and 4	25060	14800	1300	12000

Missoula Parks Trail Maintenance Services & Standards Worksheet

Task/Activity	Area	Standard for LLOS 6 Medians	Unit Cost	Basis	Freq	Annual Cost
Herbicide Spraying	Annual Pre-Emergent	1x per season	\$ 0.0065	SF	1	\$ 240.89
	Weekly Spot Spray	28 x per season	\$ 0.0011	SF	28	\$ 771.85
Litter pick up	Trash cans	2 x per week	\$ 3.4500	EA	104	\$ 3,588.00
	Mutt Mitt Stations	2 x per week	\$ 1.1500	EA	104	\$ 478.40
	Pathway ramps	52 x per year	\$ 0.0028	SF	52	\$ 2,154.88
	Bridge pathways	52 x per year	\$ 0.0028	SF	52	\$ 3,648.74
	Medians & Tree Wells	40 x per season	\$ 0.0028	SF	40	\$ 2,806.72
Vegetation management	Tree pruning (visibility)	2 x per growing season	\$ 0.0060	SF	2	\$ 300.72
	Shrub pruning	5 x per growing season	\$ 0.0120	SF	5	\$ 1,503.60
	Ground cover prune	2 x per growing season	\$ 0.0120	SF	2	\$ 601.44
	Perennial clean-up	1 x per growing season	\$ 0.0250	SF	1	\$ 626.50
	Edge mowing	6 x per year	\$ 0.0850	LF	4	\$ 884.00
Fertilization	Medians & Tree Wells	1 x per growing season	\$ 0.0100	SF	1	\$ 250.60
Pest control	Medians & Tree Wells	6 x per growing season	\$ 0.0030	SF	6	\$ 451.08
Vandalism	City Maintenance Properties	Within 48 hours of report	\$ 108.0000	LS	4	\$ 432.00
Irrigation Systems Maint	Weekly check	26 x per year	\$ 0.0024	SF	26	\$ 1,563.74
	Start-up and shut down	2 x season	\$ 0.0036	SF	2	\$ 180.43
Pathway Hardscape Cleaning	Bridge pathways	7 x per year	\$ 0.0580	LF	7	\$ 365.40
	Pathway ramps	7 x per year	\$ 0.0580	LF	7	\$ 162.40
	Pedestrian refuges	7 x per year	\$ 0.0500	SF	7	\$ 147.00
Annual Sand Removal	Bridge pathways	1 x per year	\$ 0.1731	LF	1	\$ 155.79
	Pathway ramps	1 x per year	\$ 0.1731	LF	1	\$ 69.24
	Pedestrian refuges	1 x per year	\$ 1.7500	SF	1	\$ 735.00
Snow Removal	Bridge pathways	20 x per year	\$ 0.3250	LF	20	\$ 5,850.00
	Pathway ramps	20 x per year	\$ 0.1075	LF	20	\$ 903.00
	Pedestrian refuges	20 x per year	\$ 0.0833	SF	20	\$ 699.97

Subtotal Annual Direct Maintenance Cost Est. for identified services	\$ 29,571.39
Subtotal Annual Indirect Staff Costs (planning, purchasing, load, equip/activity prep, etc....)	\$ 7,392.85
Subtotal Annual Materials	\$ 1,400.00
Subtotal Annual Estimated Utility Costs	\$ 2,220.00
TOTAL ESTIMATED ANNUAL COSTS	\$ 40,584.24
Estimated Maintenance Cost Per Square Foot	\$ 1.62

APPENDIX C

**City of Missoula
GENERAL PLAN SHEET NOTES**

GENERAL NOTES:

1. Perform all work shown on plans in conformance with City of Missoula Landscape Specifications and Details.
2. Notify Montana Utility Notification Center at least 48 hours prior to any excavation on this project (Phone No. 811) as required by State law.
3. Obtain the following permits prior to initiating any work on site as well as any additional permits specified by the landscape architect:

Right-of-Way Permit	_____
Encroachment Permit	_____
SWPPP Permit	_____
Park Vehicle Access Permit	_____
_____ Permit	_____
_____ Permit	_____

(Note: The landscape architect must identify and fill in any additional necessary permits necessary to complete.)

4. Contact the city forester or Development Services Department representative 48 hours prior to excavating within the tree protection zone of existing trees or near city owned landscape or recreation facilities. Take precautions not to damage any existing trees and facilities including underground utilities, pipes, structures, and traffic signal loops. Use any alternate means available to avoid damage to the roots of trees or underground facilities. Such methods include, but are not limited to hand trenching, pneumatic or hydraulic excavation, tunneling, probing or equipment substitution. It is the contractor's responsibility to replace or repair such trees and facilities at his own expense if damage occurs.
5. Adjust all existing utility pull boxes, monuments, valves, manholes, etc., as necessary to meet finish grades shown on the plans. This is the contractor's responsibility.
6. Keep all planting, paving, and curb areas, including the paved nose areas, free from weeds, debris and trash during the entire duration of the contract. Contractor shall apply pre-emergent herbicides per specifications. Broad spectrum weed control herbicides may be applied if the city inspector deems it necessary. Type of herbicide to be used and method of application shall be approved by the Missoula Parks and Recreation.
7. Provide "As-Built" plans to the city **prior** to completing the 90-day maintenance period.
8. A minimum plant establishment and maintenance period shall be 90 days and include, but not be limited to, all watering, weeding, staking and plant replacement. The plant establishment and maintenance period may be longer as called for in the Special Provisions.

PRE-CONSTRUCTION MEETING

1. Facilitate a pre-construction meeting. The project manager or landscape architect is responsible for running the meeting. The attendees shall include the contractor, all sub-contractors, the owner's representative assigned to the project, the city forester and the project landscape architect.
2. Notify the Engineering Division of the Development Services Department prior to starting work to arrange for any encroachment permits.
3. Notify the Building Division of the Development Services Department prior to starting work to arrange for any building permits.

PROGRESS MEETINGS

1. Weekly progress meetings shall be held to discuss work completed to date, future work, and to discuss construction issues. The attendees shall include the contractor, all sub-contractors, the owner's representative assigned to the project and the project landscape architect. The PTDDM may attend some or all of the weekly meetings depending on the size and scope of the project. PTDDM attendance will be established at the pre-construction meeting.
2. Host the weekly meeting. The owner's representative shall define the agenda and run the meeting.

SURVEY MONUMENTS

1. Survey monuments must remain intact and undisturbed unless otherwise indicated on the improvement plans. When the existing monuments must be removed and reset to perform the work in this contract:
 - a. Re-install survey monuments per city standards using a licensed Land Surveyor.
 - b. Use reference monuments specified by the City Engineer.

MATERIALS SUBMITTALS

1. Provide materials and process submittals or samples for approval before purchasing materials or equipment for the project. The submittals must be approved by the owner's representative. Any deviation from the approved plans or specifications must be approved by the owner's representative.
2. The owner's representative will review materials as they are delivered to the site. Materials not conforming to the approved submittals will be rejected. Where pre-delivery inspection and approval of materials is called for by the specifications, the contractor shall arrange for the inspection.
3. Provide off-site samples of completed work product for pre-inspection and approval where specific construction processes are called for on the plans or in the specifications.

EXCAVATION OF EXISTING SOIL AND PLACEMENT OF IMPORTED TOPSOIL

Topsoil and adequate soil preparation are essential for optimal plant growth. To provide adequate soil oxygen and encourage optimal root growth, proper drainage must be provided for all planting locations.

1. All topsoil delivered shall meet the project specifications. Soil sample(s) and report(s) shall be submitted to city inspector for approval prior to the delivery of any topsoil to the site. The owner's representative may require their presence for sampling as material is delivered.
2. Remove existing soil, concrete, asphalt, road base or other debris in the median island planting areas to a depth of 30 inches below top of curb in accordance with the standard detail. Excavated material shall be replaced with imported topsoil defined on the plans or in the specifications.
3. Remove existing soil, concrete, asphalt, road base or other debris in back-up landscape areas and landscape planters to a depth of 18 inches below finished grade. Excavated material shall be replaced with imported topsoil defined on the plans or in the specifications.
4. Where existing site soil is to be used as the planting medium or when called for on the plans, compacted site soil shall be ripped to a minimum depth of 18 inches below the existing grade level. Where the existing site soil is not compacted, rip the soil surface to a minimum of 12 inches.
5. Where topsoil of a different texture is placed upon the native soil, the initial six (6) inch layer of soil shall be ripped into the native soil. Care must be taken to avoid abrupt soil horizon layers when working with differing soil texture types.
6. Construction vehicles are not to be driven on imported topsoil or native soils after ripping has taken place.

NATURAL PATHWAY CONSTRUCTION NOTES

A.1 GRAVEL PATHWAY INSTALLATION

Non-stabilized trail work is the placing of one or more non-stabilized base courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein.

EXECUTION

1. Before placing the base course, smooth and shape the surface of the underlying subgrade or subbase or base course to the cross section shown on the plans before placing the base course.
2. Do not place base course on a wet or muddy subgrade or sub-base course. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

FILTER FABRIC INSTALLATION

Surfaces to receive filter fabric:

1. Immediately prior to placing shall be free of loose or extraneous material and sharp objects that may damage the filter fabric during installation.
2. Align and place fabric in a wrinkle-free manner.
3. Overlap adjacent rolls of fabric between 12” to 18”. The preceding roll shall overlap the following roll in the direction material is being spread. Fasten fabric with staples flush with the fabric to prevent movement of fabric by placement of pathway material.
4. Repair or replace fabric damaged during placement of pathway material with sufficient fabric to comply with overlap requirements.
5. Damage to fabric resulting from contractor’s vehicles, equipment or operations shall be replaced or repaired by the contractor at the contractor’s expense.

PLACEMENT AND SPREADING

1. Mix and place the material in maximum 8 inches (20 centimeters) compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed subbase or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, subbase or base course.
2. Deposit and spread the material in a uniform layer, without segregation, to a loose depth so that when compacted, and making allowance for any filler to be blended on the road, the layer has the specified thickness.
3. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.
4. Construct each layer meeting the requirements defined in items 1 through 3. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.
5. If segregation or moisture problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material of the affected layer by alternately blading to the center and back to the edges of the street.
6. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
 - a. Apply water during the work to control dust and to maintain the base course in a damp condition.
7. Water required for compacting base gravel may be obtained from the municipal system if approved by the owner or from other sources.

FIELD DENSITY REQUIREMENTS

1. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.
2. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.

3. Provide the watering and rolling required to obtain a minimum field density of 95 percent of maximum dry density as determined by AASHTO T99. No separate compensation is made for rolling and watering the base course other than the base course bid item or items listed on the contract documents.

SURFACE TOLERANCES

1. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edge placed on the surface with its center line parallel to the center line of the street, will not have a surface deviation from the straight edge exceeding 3/8- inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters).
2. For base course receiving asphalt concrete surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations, and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).
3. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the Construction Manager. Payment for patching aggregate is at the unit price bid for the base course material.

B.1 STABILIZED PATHWAY INSTALLATION

For Stabilized trails, add the following materials and steps to the process listed for non-stabilized trails.

1. Thoroughly pre-mix Stabilizer with crushed aggregate at the rate of 15 lbs of Stabilizer per 1-ton of aggregate. Verify with Stabilizer representative for correct Stabilizer rate. During blending, note the following:
 - a. Drop-spreading of Stabilizer over preplaced aggregate or mixing by rototilling is not acceptable. Stabilizer must be mechanically blended.
 - b. Stabilizer can be blended by cement mixer, pug mill, Dakota blender or generally any paddle type blenders (no screw-type blenders).
 - c. Always blend the material DRY and leave material in mixer for several passes of the mixing paddles. Stabilizer will disappear within material quickly but may not be blended completely.
2. After blending Stabilizer into aggregate, confirm thorough blending using a ball test:
 - a. Take a handful of blended aggregate and add a few ounces of water to it.
 - b. Work around material in both hands to ensure no dry aggregate remains.
 - c. Form aggregate into ball by hand and apply pressure.
 - d. The result should be an aggregate ball with a doughy consistency that holds together. You should be able to toss the ball in your hand without it breaking apart.
3. Place the Stabilizer and aggregate mixture on the prepared base, and rake smooth to desired grade and cross section. Place sufficient material for a compacted depth of 3” in light traffic areas or a compacted depth of 4” in high traffic areas.
 - a. Do not install stabilized aggregate during rainy conditions or temperatures of 40 degrees Fahrenheit or less.
 - b. When using a paving machine, set the screed 1” thicker than the desired compacted depth.

- c. For dry installations greater than 3", individual lifts must be one-half the final thickness but no more than 2.5". Pre-moistened aggregate mix may be installed in lifts up to 5".
4. Psyllium Stabilizer is water activated. It is essential that Stabilizer be watered thoroughly through the entire depth. Apply 25 to 45 gallons of water per one ton of stabilized aggregate. During water application, test moisture penetration using a probing device reaching full depth.
 - a. When applying water during mechanical mixing, use the lowest water rate first and add water as necessary for proper installation.
 5. Stabilized aggregate mix must be compacted within a range of 6 to 48 hours after application or until the aggregate is able to accept compaction from a 1 to 5 ton roller without separation, plowing or any other physical damage to the aggregate. Temperature and humidity conditions will determine the length of time needed for the psyllium to set.
 - a. Compaction can begin when you can walk on the material without sinking in significantly and the aggregate mix does not release water.
 - b. The aggregate mix must not be allowed to dry out prior to compaction. If surface aggregate dries significantly quicker than subsurface material, lightly mist surface before compaction.
 - c. Compact the material with a 1 to 5 ton double drum roller 3 to 4 passes.
 - d. DO NOT use a vibratory roller or a vibratory plate compactor when applying compactive effort.
 6. Allow compact aggregate to dry completely. Drying time may vary depending on amount of water used and temperature and humidity conditions.
 - a. Once completely dried, the surface should be smooth, uniform and solid. No evidence of chipping or cracking.
 - b. Cured and compacted surface should be firm throughout profile with no spongy areas.
 - c. Loose material will not be present on the surface after installation but may appear after use. Surface should remain stable underneath any loose aggregate.
 - d. Stabilizer will not turn the aggregate into concrete; the crunch of the gravel should be felt under foot.
 - e. Any significant irregularities in surface should be repaired to the uniformity of entire installation.
 7. For on-going maintenance, note the following:
 - a. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand-raking the surface as needed.
 - b. During winter snow plowing, use a rubber baffle on the plow blade or plow wheels that lift the blade 1/4" off the aggregate surface.
 - c. Loose aggregate will appear on the surface (1/16 to 1/4"). If this material exceeds a 1/4 of an inch, redistribute the material over the entire surface. Water material thoroughly to the depth of 1" and compact with power roller of no less than 1000 lbs.

IRRIGATION AND PLANTING PLAN SHEET NOTES

Verify all existing conditions and water pressure prior to the start of work. If any discrepancy exists between the design and actual field conditions, notify the owner's representative immediately prior to any installation.

Where a domestic water supply is used, the meter installation shall be coordinated by the contractor. The water meter shall be installed by Missoula Water Company or its designee. The contractor is responsible for all meter and water charges until the project is accepted, at which time the contractor shall coordinate billing transfer to the city.

Provide electrical hook-up for irrigation controller. Work is to be performed by licensed electrical contractor. The contractor is responsible for all meter and electricity charges until the project is accepted, at which time the contractor shall coordinate billing transfer to the city.

Mainline and control conduit locations are diagrammatic. Locations of mains, control conduit, laterals, valves and heads are shown for visual clarity. It is the contractor's responsibility to arrange and fit all facilities into the area to be landscaped. Adjust heads to provide complete coverage of planting areas and to eliminate overspray onto streets, trails/paths and sidewalks.

A.1 GENERAL CONSTRUCTION NOTES

1. All irrigation and planting work, including soil preparation, shall be done by a licensed contractor in a professional manner.
2. Installation a working irrigation system, including but not limited to:
 - a. Coordination and make payments of water meters with Missoula Water Service for the location, connection of the irrigation mains to the new water service and obtaining all permits.
 - b. Verification of all existing piping, utility lines and wiring within the work area.
 - c. Connection of quick couplers onto existing irrigation mains.
 - d. Coordination of installation and connection to the 120V electrical service point.
 - e. Trenching and backfilling of trenches.
 - f. Maintenance and guarantee of the irrigation system.
3. Prepare and install the planting areas including, but not limited to:
 - a. Removing all existing exposed and/or buried concrete, gravel, asphalt pavement, rocks (over 1" in size), weeds, including all underground propagules, and debris within the planting area.
 - b. Excavation of existing site soil to the depth called for on the plans and disposal off the site.
 - c. Thoroughly ripping and scarifying existing site soil in the excavated area to a depth of 18". Use smaller equipment or hand tools in tight areas where damage could occur to walks, curbing, pavement or walls.
 - d. Removal, importation and placement of good quality friable soil free from weeds, contaminants and other noxious materials to a depth called for on the plans and in the specifications.
 - e. Importation, placement and cultivation of organic soil amendment into the imported soil as called for on the plans and in the specifications.
 - f. Application of a pre-emergent weed control in the planting area.
 - g. Planting, staking and fertilizing of plant materials.
 - h. Supplying and placing of mulch within planted areas.
 - i. Maintenance and clean-up of project area during the installation work and the ninety (90) calendar day maintenance period.
 - j. Guarantee all plant materials for one (1) year after the final acceptance by the City of Missoula.

B.1 IRRIGATION NOTES

1. Irrigation plans are drawn to scale with pipe runs shown schematically. Installation shall be adjusted to meet site specific conditions.
2. The system is designed to provide 35 PSI for pop-ups and 50 PSI for rotors at the furthest head based upon a system pressure of _____ PSI at the Point of Connection (POC) of the service line to the Missoula Water main. A pressure check shall be taken prior to the start of construction to verify service pressures. If the actual working pressure falls below _____ PSI, the owner's representative shall be contacted immediately before installation work begins. If pressure is greater than 70 PSI, owner's representative shall be contacted immediately before installation work begins.
3. Hydraulically pressure test the irrigation main at 150 PSI Static Pressure for two (2) hours and be approved by the owner's representative prior to filling trenches.
4. Deliver completed warranty cards for the automatic controller and other remaining irrigation materials to the city inspector prior to final acceptance.
5. Set the system to operate from 11:00 P.M. to 7:00 A.M. only.
6. Adjust the irrigation system to prevent over spray onto adjacent streets or sidewalks.
7. Install all equipment per manufacturer specifications.
8. Complete all irrigation work per city details.
9. Complete all work to conform with local codes and regulations.

B.2 IRRIGATION MATERIALS

Use only new and fully functioning materials and equipment during installation, including:

1. Pipes shall be:
 - a. Schedule 40 PVC for pressurized main line up to 2" and Class 315 on mainline 3" and larger; 1" minimum size.
 - b. Lateral lines shall be Schedule 40 PVC, 1" minimum size.
 - c. Conduit shall be Schedule 40 PVC.
2. Fittings shall be:
 - a. Schedule 40 PVC and Schedule 80 PVC, as called for on the plans.
 - b. Galvanized steel.
3. Risers shall be:
 - a. Schedule 80 PVC, 1/2", 3/4" or 1".
 - b. Schedule 40 galvanized steel for fixed-impact heads.
4. Swing joints shall be pre-formed; no Marlex or other similar fittings are to be used to make up a swing joint
 - a. Rainbird SA, or approved equal, series triple swing joints for pop-up bodies, sized to match body inlet or approved equal.
 - b. Rainbird TSJ, or approved equal, series triple swing joints for rotor bodies and quick coupler valves (QCV), sized to match body inlet or approved equal.
5. Remote control valve boxes shall be Carson, Brooks or Ametek with locking covers.
6. Wire shall be single strand copper sized for the length of run. White for the common wire shall be a minimum of No. 14 gauge. All control wires must be suitable for use in conduit and be looped up a minimum of 3 feet in every valve box intercepted on the way to the controller.
7. Reduced pressure backflow device, ball valves, electric solenoid valves, quick coupler valves and controllers

shall be the working model and size specified in the irrigation legend.

8. Pipe glue shall be Regular-Bodied Clear cement for use on all schedules and classes of PVC pipe and fittings up to 4" for Sch. 40 and up to 2" for Sch. 80; Medium-Bodied Clear or Medium-Bodied Gray cement for use on all schedules and classes of PVC pipe and fittings up to 6" for Sch. 40 and up to 3" for Sch. 80; Lo-V.O.C.; meeting ASTM D-2564; suitable for potable water, pressure pipe and conduit; and, with a recommended application temperature 40°F to 110°F. **Red-Hot Blue glue shall not be used.**
9. Primer shall be Purple-tinted primer for use on PVC pipe and fittings; Lo-V.O.C.; NSF Listed; and, meeting ASTM F-656.

B.3 IRRIGATION INSTALLATION

Install irrigation per plans, including the following:

1. All irrigation piping running parallel to the planting areas shall be installed in the planter areas.
2. Heads, location of heads and pipe sizes shall be as per plan.
3. Pipe shall be installed in trenches no less than 6 inches wide and free from debris and rocks over one inch in diameter. All non-threaded PVC joints shall be solvent welded.
4. Pipes shall be installed at the following depths:
 - a. Main line supply, 18" of cover in general landscape areas and 24" of cover in parks and sports fields;
 - b. Lateral lines, 12" of cover in general landscape areas and 18" of cover in park and sports fields.
5. Plastic fittings shall be a minimum of 18 inches apart to facilitate removal and replacement of individual fittings
6. Schedule 40 pipe or HDPE sleeves shall be placed under all paved areas. Trench shading-sand and backfill material shall be placed as shown on the plans and compacted in 6-inch lifts.
7. All lines shall be flushed and checked for leaks prior to backfilling of trenches. Repairs shall be made while the piping is still exposed.
8. Shrub and strip heads shall be placed no farther than 6" from walls or fences. Shrub and strip heads adjacent to sidewalks shall be located 3" behind the walk.
9. Manual ball valves shall be installed in a valve box. Locking valve box shall correspond to the size of the valve, with the minimum size being 10" locking round.
10. Install reduced pressure backflow device and filter assemblies as per details.
11. Remote control valves shall be located in valve boxes placed with the planting areas with the top of boxes set flush with the finish grade. All electrical connections shall be protected with Rainbird "Snap-Tite" grease filled connectors, or approved equal grease filled connector.
12. Control wire conduit shall be placed in the same trench at the same depth as the main line. Provide a minimum of 3" separation between irrigation main line and control wire conduit. Conduit shall not be placed under or over the mainline.
13. Model 44 RC, or approved equal, QCVs shall be 2" below in a valve box when installed in turf. QCV shall be placed within 12 inches from the edge of the sidewalk or curb.
14. Prior to backfilling, the completed mainline shall be pressure tested to 150 PSI for a period not less than two (2) hours. A "completed" mainline includes the installation of **all** mainline pipe, fittings, valves and quick couplers.

C.1 FINISH GRADING AND PLANT INSTALLATION

Complete finish grading and plant installation per the following:

1. Finish grading shall consist of finely finished surfaces by raking smoothly and evenly, removing all extraneous

matter to facilitate natural runoff. Finish grades shall slope to drain, without water pockets or irregularities greater than ½” in depth. Finish grades shall meet all existing controls and shall be one inch below tops of sidewalks or curbs. Grades shall be of uniform slope and not to exceed 4:1 in landscape areas and 5:1 in turf areas.

2. The Planting Plan is drawn to scale. Planting should be located in the relative locations shown on the plans, with adjustments for existing conditions allowed. Spacing on shrubs and ground covers shall be as called for on the Planting Plan. Final planting locations shall be approved by the owner’s representative.
3. Plant trees, shrubs and ground covers only during periods which are normal for such work as determined by the season, weather and accepted practice. The Contractor may elect to conduct planting operations under unseasonable conditions. However, if plants fail after planting, the Contractor is responsible for replacing failed plants at no cost to the city. In such cases, the required 90 day maintenance period will begin once seasonable conditions return.
4. All plant materials are to be inspected and approved by the owner’s representative prior to installation. Contact the owner’s representative forty-eight (48) hours prior to any planting work. Work days are defined as Monday to Friday from 7:00 AM to 4:30 PM.

C.2 LANDSCAPE MATERIALS

Provide landscape materials in accordance with the following:

1. Topsoil shall be a natural, fertile, friable loam or clay loam possessing characteristics of productive soils in naturally well drained areas and shall be free from subsoil, construction contaminants, noxious weeds or any other material harmful to plant growth. Submit sample and soils analysis report prior to delivery to site. The soil be in the pH range of 6.0 to 7.8, with a SAR of 0 - 3, and an Ece of 0 - 2.
2. Amendments and commercial fertilizers shall be incorporated at the rates called for in the project specifications or on the project plans. The amendments shall be thoroughly incorporated into the top 6” of soil.
3. Planting backfill shall consist of existing site soil, less any rocks or debris over 1” in diameter.
4. Water shall be suitable for irrigation and free of contaminants harmful to plant growth.
5. Supports for trees shall be two 3-inch diameter treated lodgepole pine stakes. See Detail PR-101 for spacing information.
6. Plant materials provided shall be the quantity, genus, species, variety, size, and condition as shown on the Planting Plan and plant list. Plants are to be healthy nursery stock meeting the current ANSI Z60.1 Standard, and as specified on the plant legend. Trees shall be well branched, with central leaders intact, and free from disease, insect, injury or weeds. Roots on potted groundcovers, grasses or shrubs shall not be pot-bound, and be free from circling and girdling roots. Trees shall be free of circling and girdling roots, and be free of adventitious roots in excess of ½”.
7. Provide clean, dry mulch materials for the entire planting area, consisting of ¾” to 1 ¼” fir bark, or approved equal, free from foreign and harmful materials. Submit mulch sample prior to delivery to the site.
8. Pre-emergent weed control shall be an application of Surflan, or approved oryzalin equal, applied at manufacture's recommended rate and application method.

C.3 LANDSCAPE INSTALLATION

Install landscaping in accordance with the following:

1. Remove all existing soil, concrete, asphalt, road base or other debris to a depth of 30” in median planter areas and replace with imported topsoil as shown in Detail PR-127. Remove surface concrete, asphalt, base and other debris in areas other than median island planters.
2. The Contractor shall remove existing soil, concrete, asphalt, road base or other debris in landscape planters to a depth of 18” below finish grade as shown in Detail PR-126. Excavated material shall be replaced with imported topsoil defined on the plans or in the specifications.
3. Rip compacted native soil to a depth of 18” below existing grade level as shown in Detail PR-126. Where native soil is not compacted, rip to a depth of 12” below existing grade before placing imported topsoil on site.
4. Place the initial topsoil in a 6” lift. Scarify the first lift into the native soil to eliminate soil texture barriers. Add the remaining soil.
5. Evenly spread organic and fertilizer amendments to the depth called for by the landscape architect. Thoroughly mix applied amendments into the top 6” of soil.
6. Mixed soil shall be raked and otherwise sufficiently worked so that the soil level is one inch below the top of the curb or sidewalk, or as shown on the plans.
7. Planting holes shall be 3 times the rootball diameter. Place trees and shrubs plumb and faced to give best appearance or relationship to adjacent plants and structures. Backfill planting holes as per the city details
8. Slow-release plant tabs, if called for, shall be placed within the lower two-thirds of the root ball.
9. Form basins around trees and shrubs as indicated on the planting details. Stake trees if called for on the plans.
10. The planting area shall be restored to finish grades after planting. Fill any low areas after settling.
11. After each planting area is finished, apply the pre-emergent weed control as specified using the manufacturer's recommended application rate and method.
12. Apply a uniform 3” layer of fir bark mulch in all landscaped areas. Remove mulch from plant foliage and paved areas. Hose down all mulched areas with a fine spray of water.
13. All areas of work shall be kept in a neat and orderly condition at all times. Where public access is available to the site, provide public protection measures as necessary. Cleanup of the area will be required prior to final acceptance for operations and maintenance by the City of Missoula.

D.1 GRAFFITI PROTECTION

Apply anti-graffiti protection in accordance with the following:

1. Graffiti Protection

Anti-graffiti coating shall be as manufactured by Monopole Inc. Materials shall be applied as specified below:

- 1st Coat: Aquaseal ME12 (Item 5200)
- 2nd Coat: Permashield Base (Item 6100)
- 3rd Coat: Permashield Premium (Item 5600 for matte finish or Item 5650 for gloss finish)
- 4th Coat: Permashield Premium (Item 5600 for matte finish or Item 5650 for gloss finish)

E.1 MAINTENANCE

Provide maintenance activities in accordance with the following:

1. Maintenance shall be the responsibility of the Contractor during construction maintenance period and during the 90 calendar day maintenance period.
90-Day maintenance activities include, but are not limited to:
 - Irrigation system operations and maintenance
 - Weed and pest control
 - Pruning and mowing
 - Plant replacement
2. The 90 calendar day maintenance period shall commence upon the 100% completion of the project and acceptance by the owner's representative.
3. All plant material must be in a healthy growing condition and all areas weed free before acceptance for 90 calendar day maintenance period.
4. Maintain walks, drives and pavement free of hazardous materials and conditions resulting from the irrigation and planting work.
5. The general requirements of the 90 calendar day maintenance period are intended to keep all planting areas mowed, weed free, and to repair any damage to site improvements; maintain the irrigation system in good repair; replace any dead trees and shrubs with comparable healthy plant specimens; and, keep the project area neat and orderly.
6. All plant material must be in a healthy growing condition and all areas weed free before final acceptance of maintenance and operations by the City of Missoula.

F.1 GUARANTEE

Provide a guarantee for materials and workmanship, including the following:

1. The guarantee period shall commence upon the final project acceptance for operations and maintenance by the City of Missoula.
2. Guarantee the irrigation system in writing against defects in materials and workmanship for one (1) year after the final acceptance of maintenance and operation by the City of Missoula and shall furnish the city with all equipment warranties and guarantees. Repairs made during the guarantee period shall be made by the contractor without additional cost to the City of Missoula, unless the damage is a result of vandalism or city's neglect and abuse.
3. Guarantee that all soil preparation, weed control and planting were performed in accordance with these specifications and acceptable practices and that all plant materials were planted in a healthy, growing condition. Trees, shrubs, grasses and ground covers shall be guaranteed for one (1) year following final acceptance.
4. The guarantee period shall be at no additional cost to the City of Missoula.

G.1 "AS-BUILT" PLANS

Provide "As-Built" plans in accordance with the following:

1. **NOTE: The project will not be accepted for maintenance and operations by the City of Missoula, nor the warranty period started, until the As-Built drawings are received by the Missoula Parks and Recreation.**
2. All As-Built sheets shall be 24" X 36" format. Provide legibly-marked annotations on the drawings to show actual construction.
3. Submit As-Built plans in an e-transmitted .DWG AutoCAD 2010 drawing format, and in a .PDF file format.
4. Provide a reduced drawing, 11"X17", of the actual "As-Built" irrigation system. The print shall be colored to

show the area of coverage for each valve. The drawing shall be hermetically sealed between two sheets of 10 mil laminating plastic and placed in the irrigation controller cabinet.

APPENDIX “D”

City of Missoula PROJECT SPECIAL CONDITIONS

The following special conditions must be used on projects covered by this manual. These special conditions cover project completion, asphalt work, project inspection and maintenance period activities.

COMPLETION MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS (MPWSS) SUPPLEMENTARY SPECIFICATIONS AND CONDITIONS

SPECIAL PROVISIONS MODIFYING MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS (MPWSS), SIXTH EDITION, APRIL 2010, SECTIONS 00200 AND 00500 FOR CITY OF MISSOULA LANDSCAPES, GREENWAYS AND OTHER PUBLIC RECREATION FACILITIES DESIGNS

City of Missoula Public Projects that includes Landscape and Recreation Facilities shall incorporate these special provisions to MPWSS, Section 00200 Instructions to Bidders and Section 00500 Agreements, which modify and supersede the standard MPWSS language. All provisions that are not so modified below shall remain in full force and effect.

SECTION 00200 INSTRUCTIONS TO BIDDERS

ARTICLE 9-CONTRACT TIMES

Delete and Replace Paragraph 9.1 and insert the following in its place:

“The number of days within which, or the dates by which, the Work is to be (a) Completed and (b) also completed and ready for final payment are set forth in the Agreement.”

SECTION 00500 AGREEMENT

ARTICLE 4-CONTRACT TIME

Delete and Replace paragraph A. in 4.01 Time of the Essence and insert the following in its place:

“A. All the time limits for milestones, if any, and Completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.”

Delete and Replace paragraph 4.02 Days to Achieve Substantial Completion and insert the following in its place:

“4.02 Days to achieve Completion.

A. The Work will be complete within _____ days after the date when the Contract Time commences to run as provided in paragraph 2.03 of the General Conditions.”

Delete and Replace the last sentence of 4.03 Liquidated damages. and insert the following in its place:

“Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty) Contractor shall pay Owner _____ dollars (\$_____) for each day that expires after the time specified in paragraph 4.02 for Completion until the work is complete.”

ARTICLE 6-PAYMENT PROCEDURES

Delete and Replace paragraph A.1. in 6.02 Progress Payments; Retainage: and insert the following in its place:

“1. Prior to Completion, progress payments will be made in an amount equal to the sum of the unit price items less the percentage indicated below, but in each case, less the aggregate of payment previously made and less such amounts as Engineer may determine or Owner may withhold, in accordance with paragraph 14.02 of the General Conditions.”

Delete and Replace paragraph A.2. in 6.02 Progress Payment; Retainage: and insert the following in its place:

“2. Upon Completion and at the Owner’s discretion, the amount of retainage may be further reduced if requested by the Contractor.”

SECTION 00810 SUPPLEMENTARY CONDITIONS TO THE GENERAL CONDITIONS

CITY OF MISSOULA MODIFICATIONS TO THE EJCDC C-700 STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT AND SECTION 00810 SUPPLEMENTARY CONDITIONS FOR CITY OF MISSOULA LANDSCAPES, GREENWAYS AND OTHER PUBLIC RECREATION FACILITIES DESIGN

The EJCDC C-700 Standard General Conditions of the Construction Contract and the Section 00810 Supplementary Conditions shall be incorporated into City of Missoula Public Landscape and Recreation Facilities projects as here-in modified. These modifications shall modify and supersede the standard EJCDC C-700 Standard General Conditions of the Construction Contract and the Section 00810 Supplementary Conditions, taking precedence over all. All provisions that are not so modified below shall remain in full force and effect.

EJCDC C-700 Standard General Conditions of the Construction Contract

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

Delete and Replace paragraph 13.07.A Correction Period and insert the following in its place:

“13.07 Correction Period

A. If within one year after the date of Project Completion and completion of the 90-day maintenance period (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor’s use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner’s written instructions:

1. Repair such defective land or areas; or
2. Correct such defective Work; or
3. If the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. Satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.”

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

Delete and Replace paragraph 14.04 Substantial Completion and insert the following in its place:

“14.04 Project Completion

A. When Contractor considers the entire Work complete and ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is complete and request that Engineer initiate the 90-day maintenance

period.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work complete, Engineer will initiate the 90-day maintenance period. Contractor shall begin 90-day maintenance activities.

D. Contractor shall diligently undertake and complete 90-day maintenance activities as described in project specifications.

E. At the end of the 90-day maintenance period, Engineer will collect and deliver all required documents and As-Built drawings to Owner and will then issue a Certificate of Completion. Maintenance by Contractor shall continue until all such required documents are received and Certificate of Completion has been issued.

E. Upon issuing Certificate of Completion, Engineer shall authorize final payment.”

Delete and Replace paragraph 14.05 Partial Utilization and insert the following in its place:

“14.05 Partial Utilization

A. Partial Utilization of the Work may only occur under the following conditions:

1. Where the Work is phased and a phase is completed.
2. Owner and Contractor agree in writing to the specific part of the Work that can be used on a limited basis by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work.”

Delete and Replace paragraph 14.07 Final Payment and insert the following in its place:

“14.07 Final Payment

A. Application for Payment:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed the 90-day maintenance period, all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by: a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

b. consent of the surety, if any, to final payment;

c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases, affidavits or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction or 90-day maintenance period and final inspection, and upon Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due:

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor."

ASPHALT MPWSS SUPPLEMENTARY SPECIFICATIONS AND CONDITIONS
SPECIAL PROVISIONS MODIFYING MONTANA PUBLIC WORKS STANDARD
SPECIFICATIONS (MPWSS), SIXTH EDITION, APRIL 2010, SECTION 02510 FOR CITY
OF MISSOULA LANDSCAPES, GREENWAYS AND OTHER PUBLIC RECREATION
FACILITIES DESIGNS

Where these revisions/modifications may conflict with other specifications or requirements, these revisions/modifications shall take precedence.

MPWSS - Section 02510 Asphalt Concrete Pavement

Part 2 Products, 2.2 Plant Mix Aggregates

Sub-part F. - Following the first sentence, insert: “Fine aggregate angularity shall achieve a minimum of 40% according to AASHTO T304, Method A. Maximum percentage of natural fines of 20%.”

Sub-part G. - Delete the first sentence following “by weight of particles” and insert: “having a minimum fracture of 75%.”

Sub-part I. Surface Course Asphalt Plant Mix Aggregate: - Insert “Parks Roadway and Parking lot pavements may be constructed of a combination of both Type A and Type B mixes as indicated by designed use requirements. Trails shall be constructed of a single lift of Type C mix, or may be constructed of a base lift of Type B mix overlaid with a Type C mix where indicated by design or use conditions.”

Part 2, 2.5 Composition of Mixes

Subpart A. General:

1. Add: “Mix Design Requirements – independent laboratory, certified by licensed engineer.”
Add: “Mix design submittal checklist is required.”; Add: “‘Warm mix’ asphalt design is allowed and encouraged for appropriate pavement use.”
3. d. Modify as follows, Add: “Incorporate other Marshall Mix design criteria according Asphalt Institute MS-2 (current edition) including: Stability, Flow, Voids, Voids in the Mineral Aggregate and Voids Filled with Asphalt.”; Add: “Target void range shall be 2-3% for trails and 3-5% for parking lots.”
3. f. Modify as follows, Add: “RAP shall be allowed to 20%, per approved mix design method. Percentage may be increased only by preapproval of owner/engineer.”
3. h. Modify as follows, Add: “Use 50 blow Marshall for high use parking lots and roadways, use 35 blow Marshall for low use parking lots and trails.”
3. j. Modify as follows, Add: “The Modified Lottman is required for mix moisture-sensitivity testing during production when anti-strip or lime is required in the mix to mitigate retained strength loss. This may be done by owner/engineer at their option.”

Subpart B. Asphalt Concrete Surface Course:

2. a. Modify as follows, following “specimen”: 35 or 50 blows depending upon surface course usage as indicated in A.3.h...; Delete: “or 50.”
2. d. Modify as follows: Following “percent...” Delete: “3-5” and insert “2-3 for trails and 3-5 for parking lots.”
2. e. Modify as follows: “Where Table 4 values differ from the Asphalt Institute MS-2 (current

edition) Marshal Mix design criteria, the A.I. MS-2 values shall take precedence.”

Part 3 Execution

Subpart 3.12 New Work:

B. Modify as follows, Following the last sentence, Add: “Prior to scheduling a paving operation , the Contractor shall submit a paving plan to the owner for approval.”

Subpart 3.9 Sampling and Testing for Acceptance:

A. Modify as follows: In the third sentence, Delete, beginning with “core testing~” and replace with: “mix samples and densities (both mat and joints).”

Subpart 3.16 Spreading and Finishing:

A.1. Modify as follows: Add: “The maximum finished lift thickness for trail surface courses shall be 3”.”

Subpart 3.17 Mechanical Pavers:

E. Modify as follows, Following the last sentence, Add: “To determine the acceptability of spread material, the meaning of the terms uniformity of surface and segregation of materials are defined as follows: Surface uniformity shall mean that the spread material surface shall be free of any noticeable variance in the texture and regularity of the material as compared to any other adjacent or nearby material. Segregation of materials shall be defined as a noticeable variation in the composition of the material in any given area of the pavement as compared to adjacent or nearby material. Any pavement demonstrating these unacceptable characteristics requires immediate stoppage of the pavement operation and must be immediately corrected to acceptable standards before continuing. Pavement that cannot be corrected must be removed and replaced before continuing with the paving operation. Rolling of such material and continuing of the paving operation shall constitute a rejection of any subsequently placed pavement.”

Subpart 3.23 Edges:

A. Modify as follows, Following the first sentence, Add: “Immediately following, or prior to, edge surface rolling, trim and compact the outside edge to a 2:1 slope ensuring a straight and stable edge that is parallel with the centerline of the pavement section. Trimming may be performed mechanically, or with an asphalt lute or rake; compaction may be performed mechanically, either within, or directly behind, the paver’s end gates or may be hand-tamped achieving a finished 2:1 sloped edge. Irregular or vertical and uncompacted edges are causes for rejection.”

Subpart 3.29 Pavement and Material Testing Requirements:

B. Modify as follows, Add: “Investigation of deficiencies shall be by random selection, with multiple samples taken by independent lab. Acceptance may, at the owner’s/engineer’s discretion, be by price reduction for density and mix volumetric & AC% deviations. The Highway Department’s basis, when possible, shall be used for reduction calculation.

Quality assurance mix testing frequency shall be based on a daily or tonnage basis, owner’s/engineer’s option.”

INSPECTION AND MAINTENANCE SUPPLEMENTARY SPECIFICATIONS AND CONDITIONS

City of Missoula Public Projects which includes Landscape and Recreation Facilities shall incorporate these special conditions. All provisions that are not so modified below shall remain in full force and effect.

“These Project Special Conditions are special provisions that modify and/or supplement in part the General or Technical Specifications of the contract. In the event of a conflict, these Project Special Conditions shall take precedence. These Project Special Conditions are incorporated into this contract:

PROJECT INSPECTION

The owner’s representative will attend the initial pre-construction meeting. At the pre-construction meeting, the owner’s representative will determine which inspection and approval process will be required:

- Submittal review
- Weekly progress meetings
- Plant material delivery
- Initial and final grading
- Initial irrigation layout and mainline pressure testing
- Hardscape layout
- Plant layout and initial planting
- Final planting inspection
- 90-Day maintenance inspection
 - Initial irrigation inspection and testing
- Post 90-Day maintenance inspection
 - Final irrigation inspection and testing
 - Warranty Inspection
- Final acceptance

The contractor shall notify the owner’s representative 48 hours (2 working days) in advance of the time and place of the pre-construction meeting.

MAINTENANCE

Maintenance shall be the responsibility of the Contractor during construction period and during the 90 calendar day maintenance period. 90-day maintenance activities include, but are not limited to:

- Irrigation system operations and maintenance.

- Weed and pest control on the entire project site.
- Pruning of shrubs, perennials and ground covers and mowing of turf and native grasses.
- Plant replacement.

Please note, for Public Recreation Facilities projects, where the Missoula Parks and Recreation will assume operations and maintenance activities, there is no longer a substantial completion phase of the inspection process. The following flowchart illustrates the final inspection process.

Missoula Parks and Recreation Completion Flow Chart

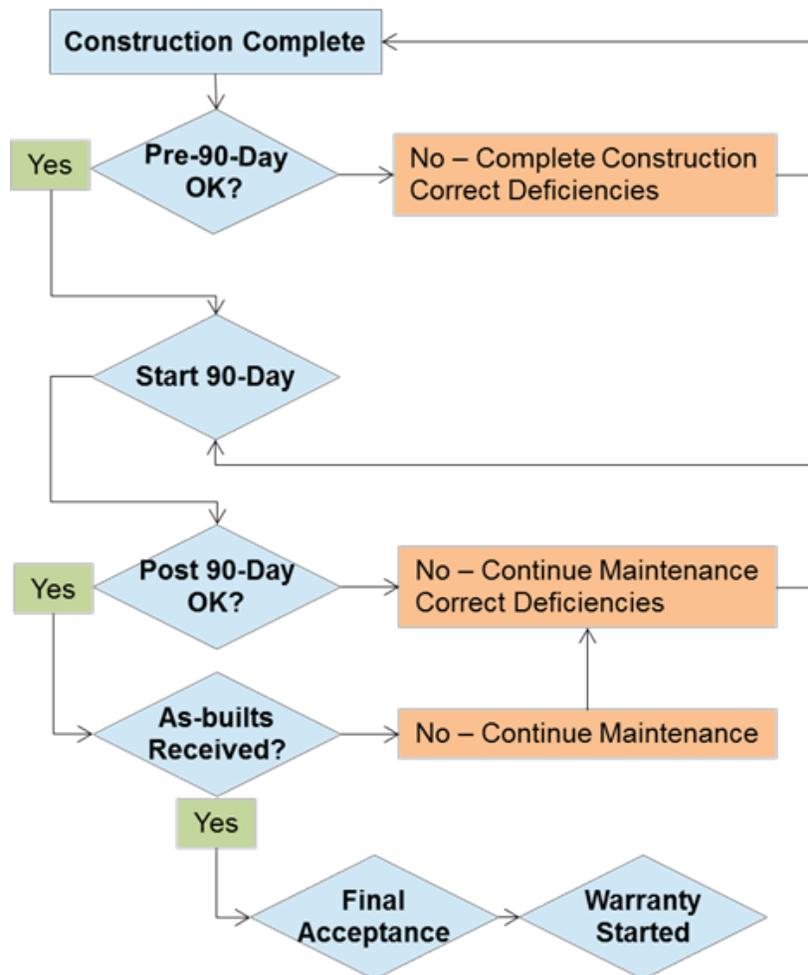


Figure D-1. Maintenance period flow chart”

APPENDIX E

City of Missoula RECOMMENDED LANDSCAPE PLANTS FOR PARKS, GREENWAYS AND ROW LANDSCAPING

Section 1 Introduction and Support

Urban environments are some of the most altered landscapes in terms of impact to native flora, fauna, and ecosystems. However, there are numerous opportunities to reduce those impacts when designing landscapes, greenways and park facilities that use both ornamental and native plant species. The purpose of this list is to provide guidance to professionals as they design public landscapes for the sustainable benefit of people and nature.

The *Our Missoula* Growth Policy has at its core the principle of sustainability. As Missoula grows, it is the responsible thing to do to encourage community and landscape design supporting ecosystem services and biodiversity, fostering integration of wild landscapes with developed landscapes in ways that benefit both, and ensuring that Missoulians are a part of not apart from nature.

Citizens consistently value Missoula's natural environment and the sense of place it creates. They value water conservation, promotion of habitat for wildlife, and our regional beauty and biodiversity. Assets that consistently rank high among residents include Missoula's rivers and streams, its conservation lands, and its urban forest and parks.

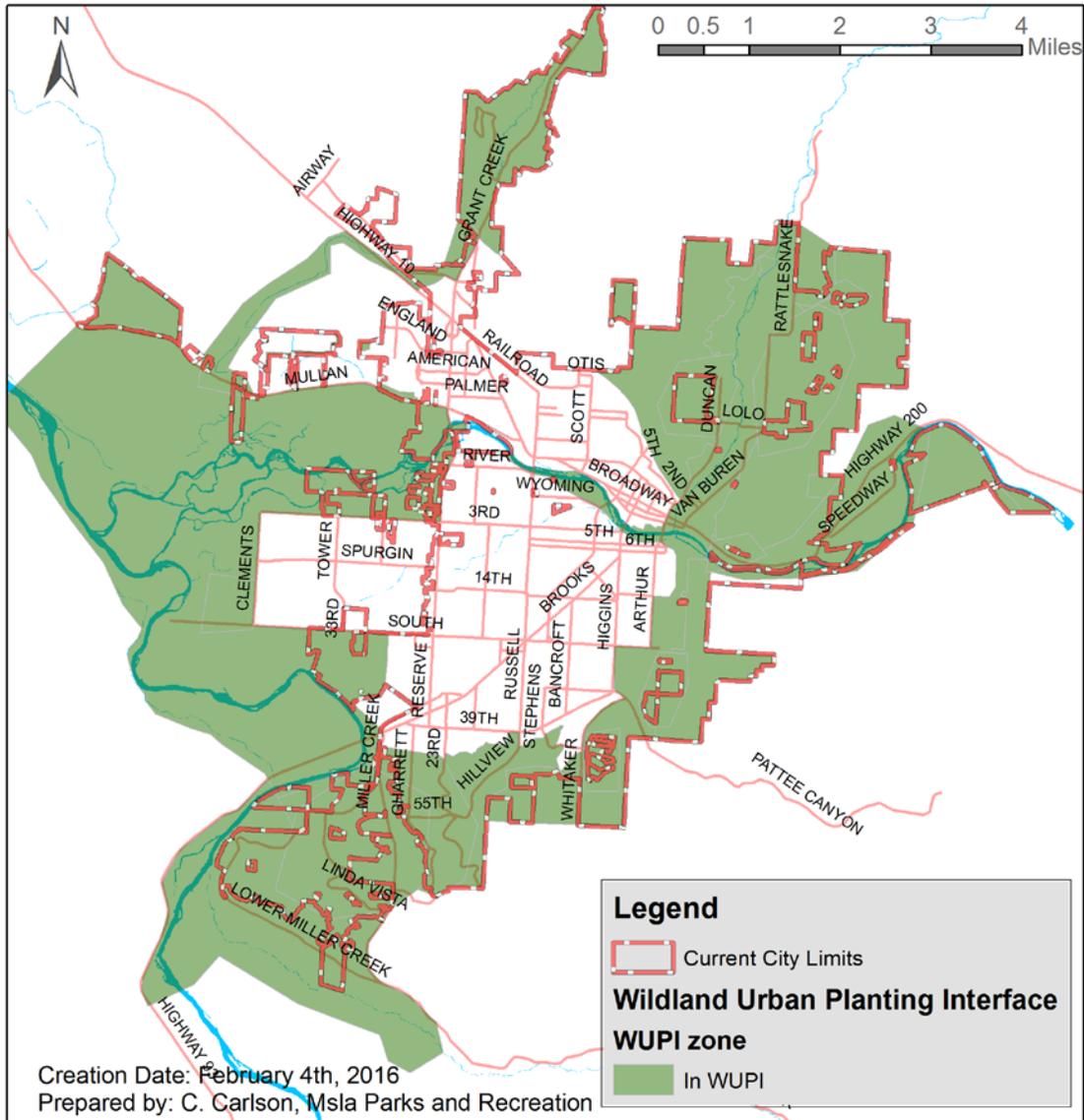
Section 2 Wildland Urban Plant Interface

This design manual establishes a Wildland Urban Plant Interface, or WUPI, defined as the wildland interface area where wildland vegetation transitions from natural habitats to fully developed urban habitats. The boundaries of the WUPI are defined in Figure F-1.

Missoula includes several riparian corridors. While not in the defined WUPI, these corridors must be considered by the landscape architect as potential avenues for non-native plants to move downstream and proliferate.

When selecting landscape plants for installations near the wildland interface, the landscape architect must exercise care to select plants that do not have the potential to escape into and invade neighboring wildland areas. Plants selected for use in this area must have an "I" or "W" designation in the Landscape Use Column in Table E-1 starting on Page 96.

Proposed Wildland Urban Planting Interface (WUPI)



Section 3 Landscape Plant Selection Considerations

When using plant lists, keep in mind that:

- In addition to species composition, habitat structure is important
- Site location and site conditions must be considered when selecting plants. For example, to achieve diversity in our urban forest and meet risk management principles, right of way trees must be selected from the Approved Street Tree List
- Native plants provide important habitat for seasonal and year-round wildlife species

- Not all native plants are drought tolerant
- Not all non-native plants are water thirsty.
- While “water wise” is a good attribute, not all “water wise” plants are native.
- Drought tolerant native plants planted from container require irrigation for establishment.
- Introduced plants have the potential to “escape” into the native habitat. Proposed non-native plants not on this list will be scrutinized by PTDDM and Park Department staff to determine their potential to escape into native habitats.

Section 4

Best Management Practices to Improve Pollinator Habitat in City Landscaping

Pollinators provide vital ecosystem services but their numbers are precipitously declining worldwide. While there are multiple factors affecting this decline several of the primary drivers of pollinator loss can be alleviated by relatively simple changes in landscape design and land management practices. Urban areas often represent pollinator deserts, offering few resources to support local pollinator populations and posing significant barriers to pollinator migration. The design standards and best management practices outlined below will provide increased resources for pollinators in Missoula’s urban landscaping.

- Incorporate a minimum of 50% flowering plants in all landscape beds.
- Choose a suite of plants to provide floral resources from mid-march until mid-October. Maximize seasonal floral resources by selecting plant species with overlapping bloom times and perennial plants with long bloom periods.
- Provide resource for multiple types of pollinators by selecting flowering plants from multiple families with different flower shapes and colors.
- Provide a diverse array of cover by utilizing both deciduous and evergreen plants with varying heights.
- Incorporate Milkweed (*Asclepias*) species into landscaping to provide resources for the threatened Monarch butterfly. Preferred milkweed species for our region which also work well in landscaping include Showy milkweed (*A. speciosa*) for drier sites, and Swamp milkweed (*A. incarnata*) for wetter sites.
- Design planting beds to reduce weed densities (eg. use weed fabric, limit overhead watering, use clean fill/composted material etc.) to limit need for herbicides. If herbicide applications are needed limit applications to times when pollinators are not active or when plants are not blooming. Do not use insecticides unless it is needed to protect public safety.
- Incorporate structures (eg. logs, bee boxes, wooden fence posts) that promote nest sites for solitary bees. Allow for some unmulched areas and/or install soil pots 8-10in deep and/or top dress with compost (<1in deep) to provide for ground nesting pollinators.
- Consider adding water resources into landscape design. Even small catchments for rain and/or irrigation water are sufficient for most insect pollinators.

- In low-use irrigated lawns reduce mowing regimes to once every 2-3 weeks to promote flower resources. Incorporate natural meadows/grasslands which require little to no mowing into landscape design for unused park space.

Section 5 Dryland Seed Mixes

Dry meadow seed mixes: The following seed mixes were developed for low-use park land and public natural areas in Missoula. Dry meadows provide habitat for wildlife and require less resources to establish and maintain, but are not maintenance free alternatives to turf grass. Establishing a dry meadow without irrigation is possible but requires a minimum of 2 growing seasons. Providing supplemental irrigation will decrease the amount of time needed for establishment but overwatering and/or continuing to irrigate after the dry meadow is established will create significant weed growth and can cause the seeding to fail.

These mixes establish well on native soils but in areas where topsoil has been stripped and/or few organic material is present importing several inches of topsoil or compost may be necessary. Recommended broadcast seeding rate for bare ground is 35lbs/acre. Seeding success will be improved, and seeding rate can be decreased, if measures are taken to improve soil x seed contact (e.g., drill or slit seeding, raking or dragging, and/or applying a ¼ in. of compost over seed). Budgets for all dry meadows should include a minimum of 2 herbicide applications and supplementary seed for applications to areas with low establishment. Addition of wildflower seed to improve pollinator habitat and weed resistance should be considered after broadleaf weeds have been controlled.

Low-Stature Mixes: Vegetation grows less than 18” in height. Meadow requires little to no mowing. No irrigation necessary following establishment. Minimal irrigation during dry months will keep grasses from going dormant.

1) Developed area mix: for use in areas which DO NOT abut native/natural areas, e.g., parking lot islands, medians, parkland surrounded by irrigated lawns.

- 60% Idaho Fescue (*Festuca idahoensis*)
- 30% Sheep Fescue (*Festuca ovina*)
- 10% Sandberg’s bluegrass (*Poa Secunda*)

2) Natural area mix-for use in areas managed as native grasslands or in areas which abut native areas.

- 65% Idaho fescue (*Festuca idahoensis*)
- 10% Prairie June grass (*Koeleria macrantha*)
- 25% Sandberg’s bluegrass (*Poa secunda*)

Moderate-Stature Mix: Vegetation grows less than 30” tall. No irrigation necessary following establishment. Minimal irrigation during dry months will keep grasses from going dormant.

Mowing may be conducted but should only occur once or twice annually when grasses are senescing and/or dormant. Mowing heights should be 5in. or higher.

1) Drysite mix- General all-purpose mix for the Missoula Valley good on hillsides moderately droughty sites and/or in areas where wildflowers will be added later.

50% Bluebunch Wheatgrass (*Pseudoroegneria spicata*) variety Goldar

25% Western Wheatgrass (*Agropyron smithii*)

15% Idaho fescue (*Festuca idahoensis*)

5% Prairie June grass (*Koeleria macrantha*)

5% Sandberg's bluegrass (*Poa Secunda*)

Wildflower Mix: The following species are easy to establish by broadcast seeding and require no irrigation following establishment. These perennial wildflowers are common to the Missoula valley, are competitive with weeds, commonly available and can be added to any of the grass mixes described above. A minimum of 4 of these wildflowers should be added to a given seed mix. Vendor will recommend seeding rates and quantities.

Blanket flower (*Gaillardia aristata*)

White Yarrow (*Achillea millefolium*)

Fringed sage (*Artemesia frigida*)

Short penstemon (*Penstemon procerus*)

Wilcox's penstemon (*Penstemon wilcoxii*)

Wild bergamot (*Monardia fistulosa*)

Holboell's Rockcress (*Arabis holboellii*)

Hairy Golden Aster (*Heterotheca villosa*)

Maximilian sunflower (*Helianthus maximiliani*)

Section 6 Using This List

This list contains both native and non-native plants. Native plants on this list are known to perform well in a landscape/horticultural setting, are widely available at commercial nurseries and provide valuable habitat for local desirable wildlife.

It is the responsibility of the landscape architect to evaluate site conditions and characteristics prior to selecting plants from the Approved Street Tree List and Approved Landscape Plant List. Plants or trees not on these lists must be approved by the PTDDM prior to use on any city landscape or public park facility improvements. The PTDDM will verify the acceptability of the requested alternate plants.

The Approved Landscape Plant List is arranged by alphabetical **botanical** name. The common name follows in the next column. Plants are grouped by shrubs first, followed by perennials, succulents and groundcovers, and then by grasses.

Trees are to be selected from the city's Approved Street Tree Lists.

The Status column indicates whether the plant is a native or ornamental plant. For simplicity, only native plants are identified. The following codes are used:

- “MN” indicates a Montana native plant.

The Water Needs column identifies the amount of water the plant requires in its native habitat. Since the average rainfall in Missoula is approximately 14.7 inches, this information can be used to group plants in irrigation hydrozones. The following codes are used:

- L is Low water usage.
- L/M is Low/Moderate water usage.
- M is Moderate water usage.
- M/H is Moderate/High water usage.
- H is High Water usage.

The Growth Form column identifies the general space requirement for the plant and its position in the landscape. The following codes are used:

- P denotes Prostrate growth habit.
- S denotes Spreading growth habit.
- C denotes Clumping growth habit.
- O denotes Open growth habit.

The Use column identifies the typical use location for the plant. Not all plants are appropriate for all sites. The following codes are used:

- M denotes Median site usage.
- B denotes Back-up site usage.
- G denotes Greenway site usage.
- P denotes Park site usage.
- I denotes Wildland Interface site usage.
- W denotes Wildland site usage.

City of Missoula
Table E-1
RECOMMENDED PLANTS FOR PARK, GREENWAY AND ROW LANDSCAPING

Shrubs							
Botanical Name	Common Name	Status	Water Needs	Growth Form	Height	Landscape Use	Characteristics
<i>Alnus incana</i>	Western alder	MN	H	C	to 30'	GBPIW	Bird Habitat
<i>Amelanchier alnifolia</i>	Serviceberry	MN	M	C	6'-8'	GBMIW	Bird Attractor
<i>Arctostaphylos uva-ursi</i>	Bearberry	MN	M	S	3"-6"	MGPIW	Evergreen
<i>Artemisia ludoviciana</i>	Prairie sage	MN	L	P	1'-3'	MBGPIW	Evergreen
<i>Artemisia tridentata</i>	Big Sagebrush	MN	L	O	3'-6'	GIW	Bird Habitat
<i>Atriplex canescens</i>	Salt bush	MN	VL	P	1'-8'	GBPI	Butterfly/bee attractor
<i>Cercocarpus ledifolius</i>	Curleaf Mt. Mahogany	MN	L	C	4'-10'	GBPIW	Evergreen
<i>Cercocarpus montanus</i>	Alderleaf Mtn. Mahogany	MN	L	C	4'-10'	GBPIW	Evergreen
<i>Chaenomeles</i> cultivars	Flowering Quince		M/L	C	1'-3'	MBGP	Evergreen
<i>Chamaebatiaria millefolium</i>	Fern Bush	MN	M	O	3'-6'	GBPIW	Fragrant
<i>Cornus sericea</i>	Red-osier Dogwood	MN	H	C	6'-8'	GBPIW	Variegated winter stem color, needs water or shade
<i>Cotoneaster acutifolius</i>	Peking Cotoneaster		L/M	P	1.5'-15'	GP	Bee and Butterfly Attractant
<i>Daphne crerorum</i>	Rock Daphne		L/M	C/S	10"-1'	MGP	Bee attractant
<i>Dasiphoria fruticosa</i>	Shrubby cinquefoil	MN	L/M	C	1'-3'	MGBIW	Longer blooming native
<i>Deutzia gracilis</i> 'Nikko'	Deutzia		M	C	3'-10'	BGP	Mid spring to summer blooms
<i>Elaeagnus commutata</i>	Silverberry	MN	M	C	4'-12'	GBPIW	Bird Attractor
<i>Ericameria nauseosus</i>	Yellow Rabbitbrush	MCN	L		1-4'		No <i>Ericameria</i> rabbitbrush in medians
<i>Forsythia X intermedia</i>	Forsythia		L	C	5'-12'	GBPIW	Early spring color
<i>Holodiscus discolor</i>	Ocean Spray	MN	M	C	3-10'	GBPIW	Bird Attractor
<i>Hydrangea arborescens</i> 'Annabelle'	Annabelle Hydrangea		M	C	2'-5'	GBP	Shade to part shade, listed as sterile
<i>Juniperus horizontalis</i>	Junipers		L	C/S	6"-10"	MBGP	Evergreen
<i>Juniperus chinensis</i> cultivars	Upright Juniper		L/M	C	5'-20'	BGPI	Evergreen

Shrubs – Continued							
Botanical Name	Common Name	Status	Water Needs	Growth Form	Height	Landscape Use	Characteristics
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	MN	L	C	5'-20'	BGPIW	Evergreen
<i>Mahonia aquifolium</i>	Oregon Grape	MN	L	C	2'-5'	MBGPIW	Evergreen
<i>Mahonia repens</i>	Creeping Oregon Grape	MN	L	P	6"-12"	MBGPIW	Evergreen
<i>Philadelphus lewisii</i>	Mock orange	MN	L	C	3'-6'	MBGPIW	Fragrant
<i>Philadelphus virginalis</i>	Mock orange Miniature		L	C	1'-3'	MBGP	Fragrant
<i>Physocarpus alternans</i>	Dwarf Ninebark		L	C	1'-3'	MBGP	Bark has winter interest
<i>Physocarpus</i> cultivars	Ninebark		L	C	3'-6'	MGBP	Bark has winter interest
<i>Physocarpus malvaceus</i>	Ninebark	MN	L	C	3'-5'	MGBPIW	Bark has winter interest
<i>Picea abies nidiformis</i>	Birdsnest Spruce		M	P/C	3'-5'	MGP	Evergreen
<i>Picea glauca</i> 'Echiniformis'	Hedgehog white spruce		M	C/P	12'-30'	GBP	Evergreen
<i>Potentilla</i> cultivars	Potentilla	MN	L	C	3'-5'	MGPIW	Cultivars may be used in MGBP Only
<i>Prunus virginiana</i>	Chokecherry	MN	M	C	10'-12'	GBPIW	Bird Attractor
<i>Prunus x cistena</i>	Sand cherry		M	C	5'-7'	GBP	Bird Attractor
<i>Purshia tridentata</i>	Bitterbrush	MN	L	C	2'-6'	GBPIW	Bee attractor
<i>Rhododendron x pantantera</i>	Azalea		M	C	1'-3'	GP	Prefers acidic soils
<i>Rhus aromatica</i> 'Low Grow'	Fragrant Sumac		L	C/P	3'-8'	B	Grows to 8' diameter in beds
<i>Rhus trilobata</i>	Skunkbush Sumac	MN	L	O	1.5'-8'	GBIW	Good wildlife habitat, mimics look of poison ivy
<i>Ribes aureum</i>	Golden Currant		L/M	O	3'-5'	GPBIW	Bird Attractor
<i>Ribes sanguineum</i>	Pink Winter Currant		L/M	O	3'-5'	GPB	Bird Attractor
<i>Rosa woodsii</i>	Woods Rose	MN	L	C	2'-6'	GBPIW	Can spread in GBP bed setting
<i>Rosa x noare</i>	Carpet Rose		L/M	S	1'-3'	MGBP	Long blooming time
<i>Sambucus cerulea</i>	Blue Elderberry	MN	M	C	8'-20'	GBPIW	Attracts birds and butterflies
<i>Sambucus racemosa</i>	Black Elderberry	MN		C	8'-20'	GBPIW	Attracts birds and butterflies
<i>Shepherdia argentea</i>	Silver Buffaloberry	MN	L	C	6'-15'	GBPIW	Bird Habitat

Shrubs – Continued							
Botanical Name	Common Name	Status	Water Needs	Growth Form	Height	Landscape Use	Characteristics
<i>Shepherdia canadensis</i>	Canada Buffaloberry	MN	M	C	3'-5'	GBPIW	Bark has winter interest
<i>Spiraea douglasii</i>	Rose spirea	MN	L/M	O	2'-4'	MGPBIW	Nectar for Bees/Butterflies
<i>Spiraea X bumalda</i>	Spirea		L/M	O	2'-4'	MGPB	Good Fall Color
<i>Symphoricarpos albus</i>	Shade Snowberry	MN	L	O	1'-3'	MGPBIW	Good for bank stability
<i>Syringa pabescens</i>	Miss Kim Lilac		M	C	5'-7'	MGP	Fragrant
<i>Taxis x media</i>	Yew		M	C	3'-8'	GBP	Part shade to full sun
<i>Tetradymice canescens</i>	Horse-brush	MN	L	C	1'-4'	MGPBIW	Strong scented
<i>Viburnum opulus ssp. amercana</i> cultivars	American Cranberrybush	MN	L/M	C	2'-5'	MGBP	Fall color interest
Perennials, Succulents and Groundcovers							
Botanical Name	Common Name	Status	Water Usage	Growth Form	Height	Landscape Use	Characteristics
<i>Aconitum columbianum</i>	Monkshood	MN	M/H	C	2-3'	MBGPIW	Nectar for Bees/Butterflies
<i>Agastache urticifolia</i>	Horsemint	MN	M	C/S	2-4'	GBMIW	Nectar for Bees/Butterflies
<i>Amsonia tabernaemontana</i>	Amsonia		M/H	P	1'-3'	GP	Needs moist/humus soil
<i>Anaphalis margaritacea</i>	Pearly everlasting	MN	L	C/S	1'-2'	PGIW	Caterpillar food source
<i>Antenaria rosea</i>	Rosy Pussy Toes	MN	L	S	3"-6"	MGPIW	Evergreen
<i>Arctostaphylos uva-ursi</i>	Kinnikinnik	MN	L	S	3"-6"	MGPIW	Native stock hard to find
<i>Artemisia frigida</i>	Fringed Sage	MN	L	P	1"	MBGPIW	Silver accent plant
<i>Artemisia schmidtiana</i>	Artemisia Silver Mound		L/M	C	4"-8"	MGP	Aromatic leaves detour pests
<i>Asclepias speciosa</i>	Showy milkweed	MN	M	P	2'-3'	MGPBIW	Nectar for Bees/Butterflies
<i>Astillbe chinensis</i>	Astillbe		L/M	C	14"-18"	GBP	Part shade/sun

Perennials, Succulents and Groundcovers							
Botanical Name	Common Name	Status	Water Usage	Growth Form	Height	Landscape Use	Characteristics
<i>Bergenia purpurascens</i>	Bergenia		L/M	C/S	12"-18"	GBP	Part shade/sun
<i>Besseyia wyomingensis</i>	Prairie Kittentails	MN	L	C	3"-10"	IW	Likes higher elevations
<i>Brickellia grandiflora</i>	Large Flower Brickellia	MN	L	C	6"-12"	IW	Mid to lower elevations
<i>Campanula carpatica</i>	Bellflower		L/M	C	6"-12"	MGBP	Varies in colors
<i>Campanula rotundifolia</i>	Bluebell Bellflower	MN	L/M	C/S	6"-12"	MGBPIW	Maybe weak stemmed in full bloom
<i>Cerastium arvense</i>	Field Chickweed	MN	L	S	1"-3"	MGBPIW	May re-bloom in fall
<i>Chimicifuga</i>	Bugbane		M	C	1'-2'	GBP	Butterfly attractor
<i>Coreopsis lanceolata</i>	Coreopsis	MN	L	C	10"-2'	MGBPIW	Many Varieties
<i>Cotoneaster adpressus</i>	Creeping Cotoneaster		M	S	10"-1'	GBP	Good for bank erosion
<i>Dalea candida</i>	Slender white Prairie clover		M	P	1'-2'	GBPI	Nectar for Bees/Butterflies
<i>Dianthus caryophyllaceae</i>	Pinks		L/M	C	3"-6"	MGP	Hardy median plant
<i>Dicentra formosa</i>	Western Bleeding Heart		M/H	P	10"-2'	GBP	Shade to part shade
<i>Draba oligosperma</i>	Few-Seeded Draba	MN	L	C/S	3"-6"	MPI	Maybe hard to find
<i>Echinacea angustifolia</i>	Echinacea	MN	L	C	10"-1'	MGBPIW	Nectar for Bee's/Butterflies
<i>Echinacea purpurea</i>	Purple Coneflower		L	C	10"-1'	MGBP	Nectar for Bee's/Butterflies
<i>Echinops ritro</i>	Globe Star Thistle		L/M	C	2'-4'	MGBP	Nectar for Bee's/Butterflies
<i>Erigeron compositus</i>	Cut Leaf Daisy	MN	L/M	C/P	1'-2'	MGBP	Small Bee attractor
<i>Erigeron linearis</i>	Lanceleaf daisy	MN	L/M	C	8-12"	GBIW	Nectar for Bees/Butterflies
<i>Erigonum flavum</i>	Yellow Buckwheat	MN	L/M	C	3"-6"	MGPI	Good ground cover
<i>Erigonum microthecum</i>	Slenderbrush buckwheat		L	P	6"-1'	MGPI	Good ground cover
<i>Erigonum umbellatum</i>	Sulfur Buckwheat	MN	L	C/S	6"-1'	MGPIW	Good ground cover

Perennials, Succulents and Groundcovers							
Botanical Name	Common Name	Status	Water Usage	Growth Form	Height	Landscape Use	Characteristics
<i>Eurybia spectabilis</i>	Showy Aster	MN	L/M	S	2'-3'	GBIW	Likes dry part-shade; Pollinator plant
<i>Fragaria vesca</i>	Woodland Strawberry	MN	L/M	C/S	3"-6"	MGBP	Part shade to sun
<i>Fragaria virginia</i>	Wild Strawberry	MN	L/M	C	3"-6"	MGPIW	Shade to part shade
<i>Gaillardia x grandiflorum</i>	Blanket flower		L	P	1'-1.5'	MGBP	Long blooming time
<i>Gaillardia aristata</i>	Gaillardia /Blanket flower	MN	L	P	6"-1'	MGBPIW	Long blooming time
<i>Geranium viscosissimum</i>	Wild geranium-Cransbill	MN	L	C/S	6"-1'	MGBP	Works well under trees
<i>Geum triflorum</i>	Prairie Smoke	MN	L	P	3"-8"	MGPIW	Hardy irrigated and non-irrigated areas
<i>Gutierrezia sarothradrae</i>	Broom Snake Weed	MN	L	C	7"-3'	MGBIW	Yellow flwr shrub; Pollinator plant
<i>Helleborus orientalis</i>	Lenten Rose		M	P	6"-1'	P	Shade -protected area
<i>Hemerocallis</i> cultivars	Hybrid Daylilies		L/M	P	1'-1.5	MGBP	Multiple blooming season; no <i>H. fulva</i>
<i>Heterotheca villosa</i>	Harry Golden Aster	MN	L	C	6'-1'	MGBPIW	Hardy irrigated and non-irrigated areas
<i>Heuchera cylindrica</i>	Roundleaf Aum Root	MN	L	C	3"-8"	MGBPIW	Attracts hummingbirds, part sun
<i>Heuchera elegans</i>	Coral Bells		L/M	C	3"-8"	MGP	Shade to part sun
<i>Hyssopus officinalis</i>	Hyssop		L	S	6"-1'	MGBPIW	Nectar for Bee's/Butterflies
<i>Iris germanica</i>	Bearded Iris		L/M	P	1'-2'	MGBP	Many variations of color
<i>Lavandula angustifolia</i>	Lavender		L/M	P	6"-1.5'	MGP	Hidcote/Grosso best types for our zone
<i>Liatris punctata</i>	Dotted Gayfeather	MN	L	C	1'-2'	MGBPIW	Pollinator plant
<i>Linum lewisii</i>	Blue Flax		L	P	6"-1'	GP	Hardy irrigated and non-irrigated areas
<i>Lonicera ciliosa</i>	Orange Honeysuckle	MN	L/M	C/S	4'-10'	GBPIW	Hummingbird attractor
<i>Lupinus argenteus</i>	Silvery Lupine	MN	M	C	1'-2'	MGBPIW	Pollinator plant

Perennials, Succulents and Groundcovers - Continued							
Botanical Name	Common Name	Status	Water Usage	Growth Form	Height	Landscape Use	Characteristics
<i>Monarda fistulosa</i>	Wild beebalm	MN	M	P	2'-4'	MGBPIW	Nectar for Bees/Butterflies
<i>Oenothera caespitosa</i>	White Evening primrose	MN	L	C	3"-6"	MGPIW	Great scent
<i>Oenothera flava</i>	Yellow Evening Primrose	MN	L	C	4"-10"	MGPIW	Great scent
<i>Oenothera macrocarpa</i>	Missouri Primrose		L	C	3"-6"	MGP	Great scent
<i>Opuntia fragilis</i>	Brittle Pricklypear cactus	MN	L	C	1'-1'	MGPIW	Plant in a protected area in GP
<i>Opuntia polyacantha</i>	Plains Pricklypear	MN	VL/L	C	1"-6"	MGIW	Plant in a protected area in G
<i>Penstemon cyaneus</i>	Dark Blue Penstemon		L	P	1'-2'	MGP	Pollinator plant
<i>Penstemon eatonii</i>	Firecracker penstemon		L	P	1'-3'	MGP	Attracts hummingbirds
<i>Penstemon eriantherus</i>	Fuzzy Tongue Penstamon	MN	L	P	1'-2'	MGPIW	Attracts hummingbirds
<i>Penstemon nitidus</i>	Shining Penstamon	MN	L	P	1'-3'	MGPIW	Attracts hummingbirds
<i>Penstemon pinifolius</i>	Pine-Leaf Penstemon	MN	L	P	1'-4'	MGPIW	Full sun and well-drained soil
<i>Penstemon wilcoxii</i>	Wilcox Penstamon	MN	L	P	1'-4'	MGPIW	Full sun, well-drained soil
<i>Phlox hoodii</i>	Phlox	MN	VL/L	P/S	2"-6"	MGP	Pollinator plant
<i>Platycodon grandiflorus</i>	Balloon flower		L	C/S	3"-6"	MGP	Good median plant
<i>Pulsatilla patens</i>	Pasque Flower	MN	M	C	1'-2'	MGBPIW	Pollinator plant
<i>Penstemon digitalis</i>	Red husker pentsimon		M	C	1'-3'	GBP	Attracts hummingbirds
<i>Ratibida columnifera</i>	Mexican Hat	MN	L	P	6"-1'	MGPIW	Pollinator plant
<i>Rudbeckia fulgida</i>	Black Eyed Susan		L	C	6"-1'	MGBP	Good median plant
<i>Rudbeckia hirta</i>	Rudbeckia	MN	L	C	6"-1'	MGBPIW	Pollinator plant

Perennials, Succulents and Groundcovers - Continued

Botanical Name	Common Name	Status	Water Usage	Growth Form	Height	Landscape Use	Characteristics
<i>Salvia X sylvestris</i> 'May Night'	Meadow Sage May Night		L/M	C/P	8"-1'	MGBP	Attracts Bees/Butterflies
<i>Salvia officianalis</i>	Sage Berggarten		L/M	P	10"-1'	MGBP	Nectar for Bees/Butterflies
<i>Sedum</i>	Stonecrop		L/M	C/P	3'-1'	MGBP	Good median plant
<i>Sedum stenopetalum</i>	Sedum	MN	L	S	3"-6"	MGBPIW	Good ground cover
<i>Sempervivum tectorum</i>	Hens and Chicks		L/M	S/C	3"-6"	GP	Full sun or light shade
<i>Solidago multiradiata</i>	Mountain Goldenrod		L/M	C/P	1'-2'	IW	Good for bank stability
<i>Stachys byzantina</i>	Lambs Ear		L/M	S	6"-1'	GBPI	May be aggressive in beds
<i>Symphyotrichum laeve</i>	Smooth blue aster	MN	L/M	P/C	1.5'-3'	MGBP	Pollinator plant
<i>Thymus vulgaris</i>	Common thyme		L/M	S/C	1"-4"	GP	Fragrant
<i>Veronica spicata</i>	Speedwell		M	C/P	10"-1'	MGBP	Full Sun afternoon shade
<i>Wyethia scabra</i>	Rough Mules Ears	MN	L	C	6"- 1'	MGBPIW	Good ground cover
<i>Yucca glauca</i>	Soapweed Yucca	MN	VL/L	C	1'-2'	MGBPIW	Beautiful flower stems up to 5'
<i>Yucca glauca</i> 'Adam's Needle'	Adams Needle Yucca		VL/L	C	1'3'	MGBPIW	Beautiful flower stems up to 5'

Grasses							
<i>Botanical Name</i>	<i>Common Name</i>	<i>Status</i>	<i>Water Usage</i>	<i>Growth Form</i>	<i>Height</i>	<i>Landscape Use</i>	<i>Characteristics</i>
<i>Agrostis idahoensis</i> cultivars	Bent Grass		H	C/S	1/16th"-1.5"	P	Blend with others sports turf types. Sports fields and park turf only.
<i>Bouteloua gracilis</i>	Blue or sideoats Grama	MN	L	C/S	1-2'	MGBPIW	Nice seed head, fall color
<i>Calamagrostis acutiflora</i>	Feather Reed Grass		L/M	C	3'-7'	GBP	Good accent color
<i>Deschampsia caespitosa</i>	Tufted Hairgrass	MN	L/M	C	2'-3'	MGBPIW	Part shade, Winter interest
<i>Festuca arundinacea</i>	Tall Fescue		M	C	3"-1'	MGBP	Good in sports turf blend; invasive wildlands
<i>Festuca brevipila</i>	Hard Fescue		M/H	C/S	2"-1'	MGBP	Good in sports turf blend
<i>Festuca glauca</i>	Sheep Fescue		L/M	C	3"-8"	MGBP	Good for weed abatement
<i>Festuca glauca</i> 'Elijah Blue'	Blue Fescue		L/M	C	6"-1'	MGBP	Good accent color
<i>Festuca idahoensis</i>	Idaho Fescue	MN	L	C	2"-2'	MGBPIW	Good accent color
<i>Festuca rubra</i>	Creeping Red Fescue		L/M	C/S	1"-3"	MGBP	Good in all turfgrass blends. Sports fields and park turf only.
<i>Festuca scabrella</i>	Rough Fescue	MN	L/M	C	1-3'	MGBPIW	Good in non-irrigated blends
<i>Helictotrichon sempervirens</i>	Blue Oat Grass		L/M	C	1'-2'	MGBP	Good accent color
<i>Koeleria macrantha</i>	Prairie Junegrass	MN	L/M	C	3"-1'	MGBPIW	Bunchgrass
<i>Lolium perenne</i>	Perennial Rye Grass		M/H	C	2"-5"	MP	Good in all turfgrass blends; many cultivars. Sports fields and park turf only.
<i>Oryzopsis hymenoides</i>	Indian Rice Grass	MN	L	C	2'-3'	MGBPIW	Bunchgrass
<i>Poa pratensis</i>	Kentucky Blue Grass		H	C/S	16th-3"	MP	See page 31 in Turf mgt. plan for cultivars, Sports fields and park turf only.
<i>Pseudoroegneria spicata</i>	Bluebunch Wheatgrass (C)	MN	L/M	C	3"- 2.5'	MGBPIW	Bunchgrass
Please be cautious with rhizomatous spreading grasses, especially near infrastructure and pavement.							

Section 7
Prohibited Plants

It is illegal to plant species designated by Montana Department of Agriculture as noxious weeds. Check with the Missoula County Weed District or the Montana Department of Agriculture to determine if a plant is on a noxious or invasive plant list. This list can be found at one of the following websites:

<http://missoulaeduplace.org/missoula-county-weed-district.html>
<http://plants.usda.gov/java/noxious?rptType=State&statefips=30>
<http://agr.mt.gov/agr/Programs/Weeds/PDF/2015WeedList.pdf>

Other prohibited plants are shown in the tables below.

City of Missoula
Table E-2
PROHIBITED TREES FOR PARK, GREENWAY AND ROW LANDSCAPING

Botanical Name	Common Name
<i>Acer platanoides</i>	Norway Maple
<i>Ailanthus altissima</i>	Tree-of-Heaven
<i>Elaeagnus angustifolia</i>	Russian Olive
<i>Frangula alnus</i>	Glossy buckthorn
<i>Tamarix spp.</i>	Saltcedar
<i>Rhamnus cathartica</i>	Common Buckthorn
<i>Salix alba</i> ‘Vitellina’	Golden Willow
<i>Ulmus pumila</i>	Siberian Elm

City of Missoula
Table E-3
PROHIBITED SHRUBS FOR PARK, GREENWAY AND ROW LANDSCAPING

Botanical Name	Common Name
<i>Berberis thunbergii</i>	Japanese Barberry
<i>Cytisus spp.</i>	Scotch Broom
<i>Euonymus elata</i>	Burning Bush
<i>Genista spp.</i>	Broom
<i>Ligustrum spp.</i>	Privet
<i>Lonicera tartarica</i>	Tataric Honeysuckle

Botanical Name	Common Name
<i>Rosa multiflora</i>	Multiflora Rose
<i>Rosa rugosa</i>	Rugosa Rose
<i>Spartium spp.</i>	Spanish Broom
<i>Syringa vulgaris</i>	Common Lilac
<i>Viburnum opulus var. opulus</i>	European High-bush Cranberry

City of Missoula

Table E-4

PROHIBITED PERENNIALS, FORBS AND GRASSES FOR PARK, GREENWAY AND ROW LANDSCAPING

Botanical Name	Common Name
<i>Ageopodium podagraria</i>	Snow on the Mountain
<i>Ajuga reptans</i>	Bugleweed
<i>Centaurea spp.</i>	Bachelor Buttons
<i>Cerastium tomentosum</i>	Snow in Summer
<i>Gypsophila spp.</i>	Baby's Breath
<i>Hedera helix</i>	English ivy
<i>Hesperis matronialis</i>	Dame's Rocket
<i>Hieracium spp.</i>	Orange or Meadow Hawkweed
<i>Lythrum salicaria</i>	Purple Loosestrife
<i>Nepeta fassenii</i>	Catmint
<i>Perovskia atriplicifolia</i>	Russian Sage
<i>Vinca spp.</i>	Periwinkle

Prohibited Grasses	
Botanical Name	Common Name
<i>Phragmites australis var. australis</i>	Common Reed
<i>Pennisetum</i> genus	Fountaingrass

APPENDIX F

City of Missoula TREE STOCK QUALITY REQUIREMENTS

Section 1 Introduction and Support

Quality tree stock suitable for use in Missoula is critical to the long-term sustainability of the urban forest. The Our Missoula Growth Policy has at its core the principle of sustainability. Purchasing quality tree stock facilitates attaining the levels of sustainability identified in the growth policy.

The purpose of these requirements is to ensure quality tree stock is purchased and planted on public projects.

Section 2 Tree Stock Requirements

Tree stock shall meet the minimum requirements listed below.

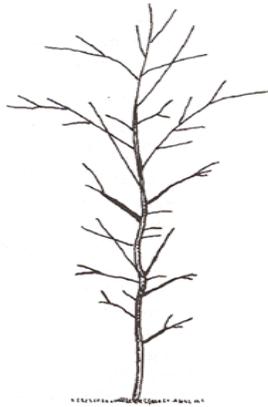
General Requirements:

1. Tree species must be true to genus, species and cultivar listed on the project plan sheets
2. Trees shall be single leader trees or multi-leaders as specified; multiple trees banded together to form a clump will be rejected.
3. Tree plant material shall meet the current, applicable American Standards for Nursery Stock ANSI – Z60.1 standards for B&B tree stock, and as supplemented below.
4. Tree stock shall be grown in a USDA no higher than zone 6A at the nursery or tree farm.
5. All stock shall be ball and burlap, unless specified as such; no container stock will be accepted otherwise.
6. The minimum size of deciduous trees shall be specified on the project plan sheets by caliper or height for conifers

Tree Health and Form Requirements:

1. As typical for the species/cultivar, trees shall be healthy and vigorous, as indicated by an inspection for the following:
 - a. Trees shall be relatively free of pests (insects, pathogens, nematodes or other injurious organisms).
2. An inspection of the crown, trunk, and roots shall find the following characteristics:
 - a. Crown Form: The form or shape of the crown is typical for a young specimen of the species/ cultivar.
 - i. The crown is not significantly deformed by wind, pruning practices, pests or other factors.
 - ii. Crown growth is evenly distributed around the tree and from the top leader to the lowest branch.

iii. Nurse branching is left in place.



Acceptable Branching



Unacceptable Branching

- b. Leaves (if present): The size, color and appearance of leaves are typical for the time of year and stage of growth of the species/cultivar.
 - i. Leaves are not stunted, misshapen, tattered, discolored (chlorotic or necrotic) or otherwise atypical.
- c. Branches: Main Branches (scaffolds): Branches should be distributed radially around and vertically along the trunk, forming a generally symmetrical crown typical for the species.
 - i. Main branches shall be well spaced.
 - ii. Branch diameter shall be no greater than $\frac{2}{3}$ (two thirds) the diameter of the trunk, measured 1" (one inch) above the branch.
 - iii. The attachment of scaffold branches shall be free of included bark.
 - iv. Shoot growth (length and diameter) throughout the crown is typical for the age/size of the species/cultivar.
 - v. Trees shall not have dead, diseased, broken, distorted or other serious branch injuries.



Acceptable Branch Spacing



Unacceptable Branch Spacing



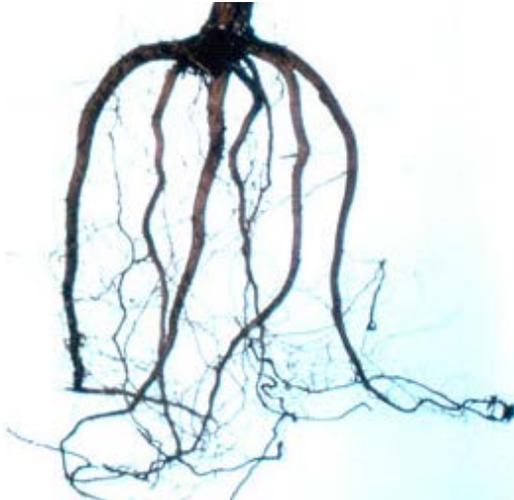
Acceptable Branch Ratio



Unacceptable Branch Ratio

- d. Trunk: The tree trunk should be straight (no more than a 5% angle change), vertical and free of wounds, sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers/lesions and girdling ties.
 - i. Proper pruning cuts for poorly attached, diseased or broken branches are allowable.
 - ii. Tree height, trunk diameter and taper are typical for the age, species/cultivar and container size.
- e. Roots: The root system is free of injury from biotic (insects, pathogens, etc.) and abiotic agents (herbicide toxicity, salt injury, excess irrigation, etc.).

- i. Root distribution is uniform throughout the soil mix or growth media and growth is typical for the species/cultivar. There should be no circling roots.



Acceptable B&B Roots



Unacceptable B&B Roots



Unacceptable B&B Roots



Unacceptable B&B Roots

- f. Central Leader: Trees shall have a single, relatively straight central leader and tapered trunk, free of co-dominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least ½ (one-half) the diameter of the original leader shall be present.

Section 3 Substitutions

Substitutions must be of the same species or cultivar group, e.g., sugar maple cultivar for a sugar maple cultivar, or a hybrid elm for a hybrid elm. Acceptance of substitutions is at the discretion of the City Forester.

Section 4 Tree Selection and Flagging

The city reserves the option of visiting the nursery and flagging acceptable trees. If trees are flagged, only flagged trees are to be delivered to the city.

APPENDIX G

City of Missoula ACCEPTABLE EQUIPMENT AND MATERIALS EQUALS

This list is updated on a periodic basis. To obtain the current list contact PTDDM, Missoula Parks and Recreation, (406) 552-6254.

A. IRRIGATION MATERIALS

1. Reduced Pressure Backflow Preventers 2” or less (assemblies shall include all necessary test cocks with full port ball valves): Febco #825Y, Wilkins #975 XL
2. Backflow Preventer Enclosures (stainless steel, free of burs and sharp edges): Le Meur BF-SS, VBSS Strong Box “Smooth Touch” SBBC-SS
3. Irrigation Controllers: Rain Bird ESP, Hunter I-CORE
4. Irrigation Controller Pedestals: Rain Bird LXMMPED, Hunter ACC-PED
5. Remote Control Valves (24-volt electric, normally closed):
 - a. Standard irrigation, Rain Bird PEB or PESB, Hunter ICV
 - b. Drip irrigation, Rain Bird XCZ-100-PRB-LC or XCZ-100-PRBR, Hunter ICZ-101
6. Quick Coupling Valves and Keys
 - a. Potable Irrigation (single lug): Rain Bird #44-LRC, Hunter HQ-44LRC
 - b. Keys for Potable Irrigation (single lug): Rain Bird, #44K HK-44
7. Irrigation Heads (all rotor heads to have stainless steel risers):
 - a. Turf Pop-Up Rotor Heads - Full Circle/Part Circle with 50-60 Foot Radius, Rain Bird Falcon 6504 SS, Hunter I-40 Ultra SS
 - b. Shrub & Turf Pop-Up Rotor Heads - Full Circle/Part Circle with 40-50 Foot Radius, Rain Bird Falcon 6504 SS, Rain Bird 5000 SS, Hunter I-40 Ultra SS, Hunter I-25 Ultra SS
 - c. Shrub & Turf Pop-Up Rotor Heads - Full Circle/Part Circle with 30-40 Foot Radius Hunter #I-20 Ultra
 - d. Shrub & Turf Pop-Up Rotor Heads – Full Circle/Part Circle with 17-30 Foot Radius, Rain Bird 3504 SS, Hunter #I-20 Ultra SS Short Radius
 - e. Shrub & Turf Pop-Up Spray Heads – Full Circle/Part Circle with 8-30 Foot Radius, Rain Bird 1800 SAM/1800 SAM PRS Body Bird w/ Rotary Nozzles, MPR40-CV Body w/ Rotator nozzles
 - f. Shrub Fixed Spray Heads – Full Circle/Part Circle, Rain Bird PA-8S Adapter, Rain Bird PA-8S PRS (pressure regulating riser), Hunter INST Institutional Series
 - g. Shrub & Turf Pop-Up Spray Heads - Full Circle/Part Circle (integral check valve) Rain Bird 1800 SAM/1800 SAM PRS, Hunter INST-CV Institutional Series
 - h. Bubblers - Pressure Compensating Flood Type, Rain Bird #1400 Series, Hunter PCN and PCB Series
8. Subterranean Drip: Netafim Techline HCVXR
9. Polyvinyl Chloride Pipe (PVC): EPCO Pacific Plastic, JM Eagle, Apache
10. Polyvinyl Chloride Pipe (PVC) Fittings: Dura, Lasco, Spears

11. Trench Marker Tape: Allen Marking Tape, Paul Potter Warning Tape, Inc. ‘Alarmatape’
12. Wire Connectors (epoxy filled): Pen-Tite (Epoxy Filled), Dri-Splice DS 100 with DS 300 Epoxy Sealant

B. ELECTRICAL

1. Meter Pedestal: TESCOFLEX® 26-000 (metered), Milbank CP3A,

C. GRAFFITI PROTECTION

2. Graffiti Protection: Monopole Inc. Materials Aquaseal ME12 (Item 5200) Permashield Base (Item 6100) Permashield Premium (Item 5600 for matte finish or Item 5650 for gloss finish)

APPENDIX H

**City of Missoula
KNOWN LAND AND WATER CONSERVATION FUND SITES
AND
KNOWN DEED RESTRICTED SITES**

City of Missoula Land and Water Conservation Fund (LWCF) Parklands
Parks
Bonner Park
Boyd Park
Caras Park (Portions)
Gregory Park
Jacobs Island
Kiwanis Park
McCormick Park (Portions)
Northside Park
Playfair Park (Portions)
Sacajawea Park
Skyview Park
Southside Lions Park
Trails
Bitterroot and Milwaukee Trails Hub
Greenough Park Trail (Missoula Bike Trail Project)
Conservation Lands
Mount Sentinel (Portions)
Rattlesnake Greenway

APPENDIX “I”

City of Missoula STANDARD DETAILS

The city’s standard details must be used on projects covered by this manual. Approved detail drawings are available in PDF format at www.missoulaparks.org.

Detail drawings may be revised on a periodic basis. It is the responsibility of the landscape architect to ensure the most current detail drawings are being used in the design.

Table I-1 Standard Details		
Detail Number	Title	Status
PR-101-1	Balled and Burlap Tree Detail	Active
PR-101-1a	Balled and Burlap Tree Notes	Active
PR-101-2	Bare Root Tree Detail	Active
PR-101-2a	Bare Root Tree Notes	Active
PR-101-3	Container Tree Detail	Active
PR-101-3a	Container Tree Notes	Active
PR-101-4	Root Barrier Detail	Under Design
PR-102	Tree Grate-Guard Detail	Active
PR-103	Container Shrub Detail	Active
PR-104	Ground Cover and Spacing Detail	Active
PR-105	Edging Detail Straight w/Splice	Active
PR-106	Edging Detail Radius w/Splice	Active
PR-107	Landscape Median Detail	Active
PR-108-1	Landscape Median Section Detail	Under Design
PR-108-2	Median Mow Band Detail	Active
PR-109-1	Pressure Reducer Backflow Detail	Active
PR-109-2	Pressure Vacuum Breaker Detail	Discontinued
PR-109-2	Backflow Enclosure	Under Design
PR-109-3	Point of Connection Layout Detail	Under Design
PR-110	Remote Control Valve Detail	Active
PR-111	Remote Control Valve Paving Detail	Active
PR-112	Quick Coupler Valve Detail	Active
PR-113	Pop-up Rotor Detail	Active
PR-114	Pop-up Spray Detail	Active
PR-115	Irrigation Trench Detail	Active
PR-116	Irrigation Trench Paving Detail	Active
PR-117	Irrigation Trench Vehicular Detail	Active
PR-118-1	Subterranean Drip Spacing Detail	Active
PR-118-2	Subterranean Drip Layout Detail	Active
PR-118-3	Subterranean Drip Flush Valve Detail	Active
PR-118-4	Subterranean Drip Air Relief Detail	Active

Table I-1 Standard Details		
Detail Number	Title	Status
PR-118-5	Subterranean Drip Tree Layout and Detail	Active
PR-119	Electrical Service	Under Design
PR-120	Well Control	Under Design
PR-121	Irrigation Controller	Under Design
PR-122-1	Non-stabilized Trail	Under Design
PR-122-2	Stabilized Trail	Under Design
PR-123	Trail Luminaires	Under Design
PR-124	Trail Luminaire Control	Under Design
PR-125	Trail Bollards	Under Design
PR-126	Planter Detail	Under Design
PR-127	Standard Trail Shade Structure Detail	Under Design
PR-128	Mutt Mitt Detail	Under Design
PR-129	Bench Detail	Under Design
PR-130	Trash Can Detail	Under Design
PR-131	Bear Can Detail	Under Design
PR-132	Drinking Fountain Detail	Under Design
PR-133	Stump Grinding Detail	Under Design
PR-134	Tree Protection Detail	Under Design

APPENDIX J

City of Missoula REFERENCE DOCUMENTS

The following City of Missoula documents were used as references in the creation of this document. Each of the documents contains one or more guiding principles that are embodied within the Missoula Parks and Recreation Design Manual. These guiding principles include, but are not limited to, sustainability, livability, environmental quality, safety and wellness community design and fiscal sustainability.

Links to these documents are included in Table J-1.

Table J-1 Missoula Parks and Recreation Design Manual Reference Materials	
Document	Link
2035 Missoula Growth Policy	http://www.ci.missoula.mt.us/1748/Our-Missoula
City Strategic Plan	http://www.ci.missoula.mt.us/documentcenter/view/25609
2004 Master Park Plan	http://www.ci.missoula.mt.us/documentcenter/view/776
2006 Missoula Urban Area Open Space Plan	http://www.ci.missoula.mt.us/documentcenter/view/652
2009 Complete Streets Resolution	http://www.ci.missoula.mt.us/documentcenter/view/1954
2010 Conservation Lands Management Plan	http://www.ci.missoula.mt.us/DocumentCenter/Home/View/4499
2011 Active Transportation Plan	http://www.ci.missoula.mt.us/DocumentCenter/Home/View/6391
2012 FMRP Master Plan	http://www.ci.missoula.mt.us/DocumentCenter/Home/View/4599
2014 Park Asset Management Plan	http://www.ci.missoula.mt.us/DocumentCenter/View/24843
2014 Turf Management Plan	http://www.ci.missoula.mt.us/DocumentCenter/View/24844
2015 Urban Forest Master Management Plan	http://www.ci.missoula.mt.us/documentcenter/view/31003

MMC 12.48.030 describes the duty of the landowner related to boulevards. MMC 12.32 describes the responsibility of the City and the landowner specific to the health and integrity of the urban forest, particularly trees within the public right of way. Thus, in order to provide clarity to contractors, developers, and designers, as well as homeowners, P&R provides the following clarification to the City of Missoula Design Standards:

APPENDIX K

City of Missoula APPLICABILITY CLARIFICATION

Public trees represent a long term investment in public infrastructure. Per MMC 12.32 the City of Missoula is responsible for long-term maintenance of these public trees in order to retain and maximize their environmental and community benefit, as well as to manage the associated risks and liability. As such, the Applicability of this Design Manual **does include** include Public Trees located within the Boulevard, and the Public Right-of-Way.

Parks and Recreation will be responsible for approval of Public Tree plans, which will include Tree Class, Spacing, Soil Volume and Species.

RESOLUTION 8232

A RESOLUTION OF THE MISSOULA CITY COUNCIL RESCINDING THE CURRENT PUBLIC LANDSCAPE AND RECREATION FACILITIES DESIGN MANUAL, AND ADOPTING THE UPDATED MISSOULA PARKS AND RECREATION DESIGN MANUAL, 2018 EDITION, AND DIRECTING STAFF TO BEGIN IMPLEMENTATION OF THE ADOPTED MISSOULA PARKS AND RECREATION DESIGN MANUAL, 2018 EDITION, IMMEDIATELY.

WHEREAS the City of Missoula has over 68 parks, over 4000 acres of conservation lands including native and natural landscapes, over 53 acres of public landscaping and over 48 miles of greenway; and

WHEREAS new public landscape and recreation facilities are being added to the existing inventory on a continual basis; and

WHEREAS, it is well established that public landscaping, greenways, natural areas, and parks are a critical thread in the community social fabric; play a critical role in the health and wellness of a community, and provide numerous socio-economic and environmental benefits; and

WHEREAS, the design and construction of public landscapes and recreational facilities represent a significant community capital expenditure; and

WHEREAS, proper design and construction of public landscape and recreation facilities leads to a longer useful lifespan and lower long-term maintenance and operations cost; and

WHEREAS, the Missoula Parks and Recreation staff has prepared the revised Missoula Parks and Recreation Design Manual to guide these ongoing design and construction efforts well into the future; and,

NOW THEREFORE BE IT RESOLVED that the Missoula City Council hereby rescinds the Public Landscape and Recreation Facilities Design Manual for the City of Missoula adopted by Resolution 8045 and replaces it with the Missoula Parks and Recreation Design Manual, 2018 Edition; and

AND BE IT FURTHER RESOLVED that the Missoula City Council authorizes and directs staff to begin implementing the Adopted Missoula Parks and Recreation Design Manual, 2018 Edition; and

AND BE IT FURTHER RESOLVED that the Missoula City Council commits the City to including the Adopted Missoula Parks and Recreation Design Manual, 2018 Edition in all future public landscape and recreation facility projects.

PASSED AND ADOPTED this 18th day of December, 2017.

ATTEST:
/s/ Martha L. Rehbein
Martha L. Rehbein
City Clerk

APPROVED:
/s/ John Engen
John Engen
Mayor

(SEAL)