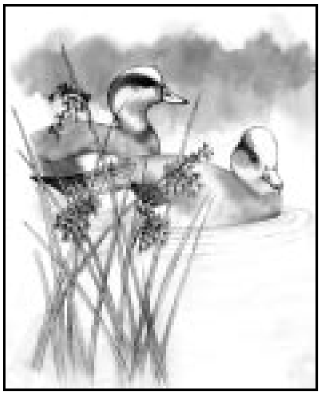

Chapter 4

How to Develop On-the-ground Conservation Measures

The previous chapter outlined the basic elements of a local government conservation program. This chap ter contains the details to consider in developing on-the-ground conservation measures. These conservation measurers can then be used in Chapters 5 and 6, which outline how Montana-specific land use tools can be used. Since vegetated buffers are widely regarded as being the most critical element of protection efforts, most of the discussion in this chapter centers on setting up effective buffers. Woven into that discussion are other elements that local decision-makers will need to consider for administration and development of a program.

Define the Resource to be Protected

Whether developing a regulatory program, creating a greenway development plan, or setting up a conservation easement, decision makers will need to determine which resources are included in protection efforts. These decisions will be based on community support, the benefits provided, and practical considerations such as the level of expertise, mapping, and site investigations required by different conservation options. This section gives an overview of the challenges and opportunities that exist as decision-makers choose which on-the-ground resources to protect.

Riparian Areas

Deciding which riparian areas should receive protection is dependent upon the desired benefits officials want to achieve. Protecting economic or aesthetic benefits may dictate establishing buffers along rivers and streams. If conservation of wildlife habitat is a goal, local biologists may indicate that certain stream corridors or watersheds are more important than others. For water quality protection, scientific research shows that riparian buffers should be established along all rivers and streams, including intermittent and ephemeral streams, to the maximum extent possible (Wenger, 1999). Because water quality protection is commonly used as the central reason why riparian buffer programs are enacted, local officials will be faced with the following three decisions as they choose which riparian resources they are willing to protect. Definitions for perennial, intermittent, and ephemeral streams appear in Box VIII.

Rivers and Perennial Streams

In order to protect water quality, it is important from a scientific perspective to preserve corridors of natural vegetation along both rivers and perennial streams. Protection of streams is particularly important because many of the degrading impacts of development are carried downstream and are amplified once they drain into main stem rivers. Consequently, the water quality and quantity in rivers is largely determined by what they receive from their many smaller tributaries. Due to their size, small streams are especially vulnerable to degradation by excessive sediment, nutrients, and other pollutants, simply because there is a smaller volume of water available to flush out and/or assimilate these pollutants (Cohen, 1997).

Ephemeral and Intermittent Streams

Scientific studies indicate that riparian buffers should be established along all intermittent and ephemeral streams (Wenger, 1999). These research findings make sense given that all streams drain downhill, and that intermittent and ephemeral streams feed directly into both perennial streams and larger river systems. However, if local officials decide not to protect all streams, research indicates that, as an alternative, riparian buffers can be established on all rivers and "all perennial streams as well as all intermittent streams of second order and higher" (Wenger, 1999). The City of Bozeman accepted this recommendation by establishing riparian setbacks along all watercourses "*in which water flows either continuously or intermittently and has a definite channel, bed, and bank*." The City of Missoula extends protection to smaller intermittent and ephemeral streams through protection of woody draws (*see Box VIII*).

Bank Stabilization and Land Use Planning

Montana's low elevation streams and rivers need room to move. In addition to protecting riparian areas, uplands located next to streams and rivers also need protection. The long-term health of riparian areas requires maintaining natural stream processes. In Montana, this natural process includes allowing many rivers and streams room to meander. If given space, this meandering creates a pattern where outside bends of a river are dominated by cut banks (caused by natural erosion), and inside bends are dominated by sand or gravel bars (where sediment is deposited). Additionally, the bends in meandering streams naturally and slowly migrate. This process, in combination with the moist, often wet soils and high water table found next to streams, creates a river's floodplain, which is often defined by riparian vegetation. Plants associated with riparian areas are adapted to growing in this dynamic system.

As more bank stabilization structures are built—weirs, riprap, barbs, and other structures—both short term and long term consequences can develop. In the short term, these structures tend to physically stabilize one local stretch of riverbank or divert flows away from one bank to another. This can trigger increases in river flow velocities, exacerbate downstream bank erosion and lead to further instabilities downstream. Over the long term, bank stabilization can cause the channelization of rivers and streams as floodplains narrow or disappear, natural stream migration is prevented, and, ultimately, riparian vegetation does not regenerate (e.g. Ellis, 2002). For more information about the problems with bank stabilization, see the Missoula County case history on page 5-18.

Local governments are beginning to grapple with the issue of what to do when people want to build their homes near a meandering stream. Built too close to the stream, landowners will eventually request that bank stabilization structures be built to protect their home. It is important to note that allowing homes to be built on a high point overlooking a stream or river will often require landowners to stabilize the stream bank below to prevent their homes from eventually falling into the water. The best way to deal with this issue is to not allow homes to be built in the floodway or active area of the floodplain; and to establish setbacks on areas located above the floodplain, but within the zone where streams will likely meander.

Wetlands

The size, density, relative importance, and location of wetlands in an area can strongly affect a community's willingness to protect them. When local governments adopt wetland protection programs, it is recommended that their approach be kept simple. This section discusses ways that local governments can decide which wetlands to protect (Kusler and Opheim, 1996).

Because the filling of wetlands is regulated under Section 404 of the federal Clean Water Act, if local governments choose to protect wetlands, they will want to coordinate all wetland protection efforts with the Army Corps of Engineers (*see Appendix IV*). In fact, if wetlands are identified on a piece of property slated for development, as part of a standard process to deal with wetlands, local governments should require the developer to submit a letter from the Corps indicating if the wetlands are regulated by the 404 program. If regulated wetlands occur on the property, local governments should then determine 1) if a delineation was completed as part of the permitting process; and 2) if the Corps approved, approved with conditions, or denied the 404 permit.

Mapped Wetlands

Many communities, where there are comparatively few wetlands and much developable land, have applied regulations only to larger wetlands. To accomplish this, a broad map of wetland areas is completed, and regulations are adopted that establish buffers around mapped wetlands. This approach has proven politically expedient and minimizes administrative problems, while preserving the more important wetlands. National Wetland Inventory (NWI), a project of the U.S. Fish & Wildlife Service, are the main source of wetland maps in Montana (*see Appendix III*). These maps are based on interpretation of aerial photographs and are projected onto USGS topographic maps. Because of their scale, some smaller wetlands may not be identified on these maps. Unfortunately, NWI maps have not been completed for most of the state. Therefore, it may be necessary to use alternative sources of information to develop base maps of local wetlands (*for alternative sources of information, see Appendix III*). Once maps are created or adopted, they can be attached to land use plans and regulations. However, to evaluate individual development proposals, field delineations of wetland boundaries are almost always necessary to refine map boundaries. Several ways to obtain wetland delineations are discussed below. Local governments interested in getting NWI maps completed for their jurisdiction should contact the DEQ Wetlands Program (*see DEQ Wetland Program, page 6-10*).

Delineated Wetlands

A second approach to wetlands protection does not require local governments to map wetlands. Under this approach, local governments rely on written guidelines, a definition of wetland resources, a delineation manual, and application of regulations on a case-by-case basis. Wetland delineations are simply the act of establishing the boundary between wetlands and uplands (or non-wetlands) using specific definitions. These definitions commonly comply with federal regulations, but not always. A “delineation” usually requires that a resource professional look at site-specific soils, plants, hydrology, and other factors to determine the actual boundary of a wetland. This approach is less expensive than mapping an entire jurisdiction and allows buffers to reflect site-specific conditions. However, it can create uncertainty and unpredictability for landowners. There are several ways to get a delineation completed for a wetland.

Rely on Federal Wetland Delineations. If a wetland is proposed to be filled from a subdivision or other development, then the developer will usually need a 404 permit from the Army Corps of Engineers (Corps) under the Clean Water Act (*see Appendix IV*). If a delineation is done as part of this process, once completed, local governments can use these delineations to determine wetland boundaries. Under this scenario, only those wetlands delineated, as a requirement of the 404 permit process, would receive protection under local regulations.

Request Developers to Delineate All Wetlands. A common method used by local governments is to require developers to delineate all wetland boundaries within the development area. This is particularly important in situations where a 404 permit may not be required (and therefore a delineation will not be completed). For example, a 404 permit may not be needed if a wetland is within the development area, but will not be filled. A local government may want to regulate impacts to these wetlands because they may be degraded by development activities and the 404 program would not establish protective buffers around them. Under this strategy, regulations would apply to all wetlands within a jurisdiction.

Develop Expertise to Determine Wetland Boundaries. A final way to get wetland boundaries established is to train local government staff or hire technical assistance to complete these delineations. In such cases, regulations can be developed that allow wetland boundaries to be determined, at least in a general way, by landowners and/or planning staff. As an example, both the city and county of Missoula have adopted standards that identify key plants associated with local wetlands. These standards were designed so that an individual with some skill, armed with a plant identification book, can usually perform the boundary identification. Planning staffs are also able to assist landowners with boundary determinations on a case-by-case basis (*see City of Missoula and Missoula County, page 5-10*).

Wetlands in Riparian Corridors

Another way to include some protection for wetlands in local regulations is to protect wetlands in riparian corridors through riparian buffers. Wetlands have long been recognized for their ability to trap water and sediment. Located in the floodplain, they also play an important role in flood control. In fact, riparian wetlands are significant enough that research supports their *automatic* inclusion in riparian buffer systems (Wenger, 1999). In this model, the width of riparian buffers should be extended by the width of all adjacent wetlands.

Functional Assessments of Wetlands

One final approach to wetland regulations is based on a functional assessment. Because all wetlands are not of equal value, some communities have decided to apply special criteria to determine which wetlands are more important to the community. A functional assessment is used to determine the level and importance of different wetland functions, such as a wetland's significance for wildlife habitat, flood prevention, and water quality improvement. This method is much more sophisticated than the above methods, and requires more time and expertise. One way that communities have handled this system is to establish a committee or board of resource specialists that is charged with evaluating wetlands in development projects on a case-by-case basis. This board is asked to complete a functional assessment of wetlands and make recommendations of condition that should be attached to development proposals. Recommendations may focus on buffer size, a list of activities that are allowed and/or prohibited, and similar measures.

Consider the Right Tool for the Job

Establishing a buffer around wetlands and riparian areas is the single most effective conservation mechanism available. Buffers are the natural, undeveloped, vegetated areas surrounding a stream or wetland. They serve as an important transition zone between wet areas and their adjacent upland. Establishing effective buffers is critical in all protection programs, including growth policies, subdivision regulations, zoning, development permit regulations, floodplain regulations, and septic system standards. This same tool is also used in conservation easements, covenants, deed restriction, and public park development plans. To begin, there are several general mechanisms used to establish a buffer around sensitive areas:

Setbacks

Setback requirements determine the allowable distance between a critical area, such as a wetland or stream, and a new development. Their size is based on a variety of factors. In Montana, local governments have generally used setbacks ranging from 50 feet on smaller streams, to 500 feet or more on rivers (*see Appendix I*). Setbacks for riparian areas are usually measured from the high water mark. Wetland setbacks are measured from the wetland's edge.

Building Envelopes

A building envelope is a geographic area delineated within a land parcel in which buildings or other structures may be located. The building envelope is drawn to include the part of the lot suitable for building that avoids damage to or degradation of sensitive areas such as wetlands, riparian vegetation, flood-prone areas, and critical wildlife habitat. Building permits, zoning, subdivision regulations, and development permits are ideal for enforcing building envelopes. Building envelopes are also used in public interest covenants (*see Public Interest Covenants, page 5-11*) and conservation easements. If they are incorporated into subdivision regulations, building envelopes can be difficult to enforce unless there is a public interest covenant attached to the subdivision. Another way to enforce building envelopes is by cooperative agreements with the county sanitarian, since Montana law requires that the local sanitarian review all new septic systems.

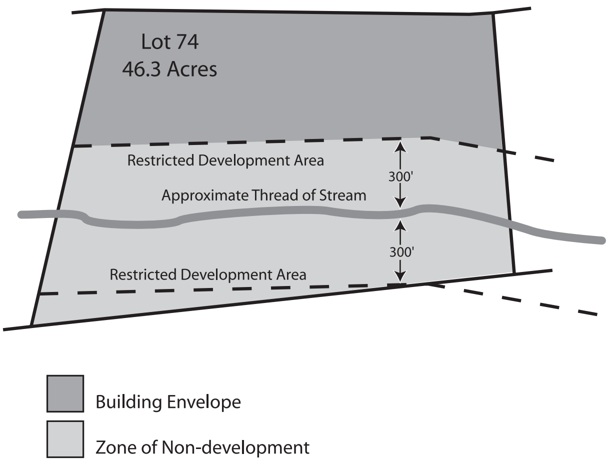

Figure 2. *The relationship of Building Envelopes to Zones of Non-development.*

Zones of Non-development

A direct means of protecting wetlands and riparian areas is to prohibit development, filling, or other alterations in specific locations—instead of a "building envelope" being drawn to establish the part of the lot suitable for building, an "envelope" is drawn around the resource area that needs protection. At least two general categories of non-development "zones" are found in Montana. These two types of zones can be used in traditional zoning regulations, development permit regulations, subdivision regulations, and conservation easements.

- "**No-build Zones**." No-build zones prohibit residential and commercial buildings. If specified, they can also include additions to an existing structure, decks, parking lots or other impervious surfaces, or similar improvements.

- "**No Improvement Zones**" or "**Zones of Non-development**." In addition to prohibiting any buildings, these zones can prohibit placement of any structures or fences (including stream bank alterations); motorized vehicle access (including roads and driveways); landscaping (including restrictions or prohibitions on tilling, mowing, fertilizing, filling or dumping) or planting of non-native species (including lawns); use of power equipment (unless part of an approved weed control program); and disturbance of native riparian vegetation. Prohibitions or seasonal restrictions on grazing can also be found in no improvement zones.

Cluster Development

Cluster development is an alternative to large-lot development. Rather than simply dividing land into large lots (e.g. 10-acre or 20-acre individual lots), under cluster development smaller lots are created (e.g. 1-acre lots), which allows the remainder of the tract to be protected as common open space. Clustering development allows smaller lots to be served by fewer linear feet of roads, water and sewer mains, and electric, telephone, and natural gas lines—saving dollars for residents, local governments, and utilities. The other major benefit is that open space can protect important resources such as wetlands and riparian areas. Because lot size and patterns are determined at the platting stage of development, cluster development is best used as a tool in subdivision regulations. In fact, the 2001 Montana Legislature added a provision to Montana's Subdivision and Platting Act that gives local governments incentives to encourage cluster development and the preservation of open space (*see 76-3-509, MCA: Local Option Cluster Development Regulations and Exemptions Authorized*).

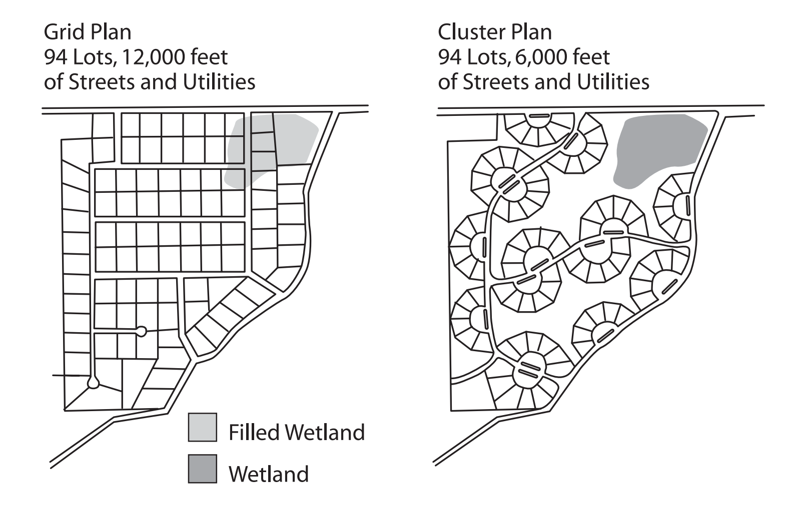

Figure 3. *Illustration of Cluster Development used to protect a wetland.*

Density Limitations

Although less effective, density limitations are a commonly used mechanism that can provide some level of protection for streams and wetlands by restricting the number of buildings allowed per acre. For example, the Milligan Canyon/ Boulder Valley Agricultural Zoning District allows only one non-agricultural building per 640 acres (*see Jefferson County, page 5-6*). Although streams or wetlands are not specifically protected when residential development is restricted to a specific lot size, protection is indirectly achieved because the lot size for new residences prevents houses from lining rivers, streams, or lakeshores. Density standards, however, should be crafted to avoid "spaghetti lots," where a series of long, narrow lots line a stream or lake. In these situations, the lots themselves meet density standards, but sensitive areas can be subject to a high density of houses. Appendix I contains a summary of the density standards used by a sampling of local governments in Montana.

— Establish a Sequence for Reviewing Individual Development Proposals —

After local governments have decided what resources they want to protect and the tools they will use to protect them, policies should be established for the review of individual development proposals. Consistent with policies adopted by federal programs, the following sequence of decisions is recommended when development of a wetland or riparian area is considered on a case-by-case basis:

- Avoid impacts by considering alternative locations;
- Minimize the impacts of a project on the resources; and
- Where impacts are unavoidable, mitigate.

Each step of this sequence is discussed below. Please note that because of the federal, state, and local regulation protect wetlands and riparian areas, avoiding, minimizing, or mitigating resource losses must be implemented in a manner consistent with applicable regulatory programs (*see Appendix IV*).

Avoidance

The best way to protect wetlands and riparian areas is to avoid projects that fill, grade, drain, or otherwise damage or destroy these resources or their adjacent uplands. If at all possible, development activities should be located on uplands. Setbacks, building envelopes, and no-build zones are effective mechanisms that can be used to "avoid" impacts to streams and wetlands.

Minimize the Area of Impact

If impacts to a wetland or riparian areas cannot be avoided, then they should be minimized. Reducing impacts can preserve at least portions of the important functions these resources provide (e.g. filtration of sediments and pollutants). Researching alternative project layouts, designs, erosion controls, and pollution control features are just a few ways to minimize impacts. A housing project, for example, might consider design options that include a fewer number of units, clustering of units, shifting the building pattern to skirt around wetlands or riparian areas, or requiring hook-ups to public sewer systems.

Mitigate Damages

When a project must impact a wetland or riparian area, local governments may require mitigation to be conducted by developers to compensate for the impacts. It should be noted that the use of mitigation might be controversial with developers because of the work and money involved, and with conservation organizations because of the mixed success of individual mitigation projects.

Mitigation can take many forms. It includes the restoration of existing degraded areas, or in the case of wetlands, the construction of human-made wetlands. Generally "preservation" of an existing area is not accepted by government agencies as a mitigation effort. As a practical matter, wetland projects that restore areas are much more successful than projects that create a new wetland. Creation is difficult to do successfully because all of the components of the system need to be functioning: soils, hydrology, and a seed source for desired plants. In contrast, restoration projects usually have all these components available, but in a degraded state. Because the success of wetland creation is mixed, it makes sense that when wetland mitigation is desired, restoration, and enhancement projects take priority.

If a local government is interested in requiring mitigation, it should set up a system to deal with mitigation projects on a case-by-case basis, including developing, monitoring, and maintaining mitigation sites. Under such a program, mitigation regulations should be clearly stated in a community's planning documents. Mitigation ratios, defining the amount and type of wetlands or riparian areas needed to replace those lost, are dependent upon the size, condition, and type of the impacted resource. Mitigation ratios of at least a 2:1 ratio, or double the area of the original resource lost, are not uncommon. Additionally, each mitigation project should have a mitigation plan that includes the following items, at a minimum:

- An evaluation of existing wetland or riparian values on both the land to be altered and the mitigation site;
- Clearly defined (and preferably measurable) goals for the mitigation site;
- Management provisions for transitional habitat between upland and the wetland/riparian area;
- A buffer zone from nearby developed areas;
- A plan for protection of the site from public access damage;
- A specific monitoring plan with targets, timelines (for example, 80% vegetative cover with the first 5 years of planting), and a reporting requirement; and
- Contingency plans, should the mitigation plan fail to achieve measurable success.

A full discussion of mitigation programs is outside the scope of this publication. As background, wetland mitigation banks, where for-profit companies sell wetland mitigation credits to developers for a fee, are used in some states as systems for creating and monitoring mitigation projects. The Army Corps of Engineers under the 404 permit program must approve all wetland mitigation banks—and there are currently no approved banks in Montana. However, state and federal agencies in Montana are currently working on local guidance for a payment-in-lieu-fee program to provide another option for mitigation of wetland and stream impacts from 404 permit activities. This program may allow developers to pay a fee for each acre of resource impacted. The funds would be collected, and made available for larger mitigation projects. The Montana Wetlands Legacy will be the likely administrator of this in-lieu-fee program (*see Montana Wetlands Legacy, page 6-13*).

Determine the Appropriate Buffer Width

The size of buffer strips depends on what the buffer is expected to do. There isn't one generic buffer width that will keep the water clean, prevent flood damage, protect fish and wildlife, and satisfy demands on the land. The minimum acceptable width is one that provides acceptable levels of all needed benefits at an acceptable cost (Connecticut River Joint Commission (CRJC), 1998). The following items should be considered in determining the size of any buffer width:

- Define the Purpose of the Buffer
- Choose a Buffer Type
- Consider Site Specific Factors—how slopes, floodplains, vegetation, and similar conditions should be factored into decisions about the activities allowed in buffers and buffer size.

Define the Purpose of the Buffer

An important step in developing conservation buffers is to determine what benefits they are expected to provide. For instance, is the goal to protect water quality, address flood control, preserve wildlife habitat, or some combination of these? Choosing different priorities may shape a regulatory program—and why several communities have chosen the priorities that they have is discussed in this section.

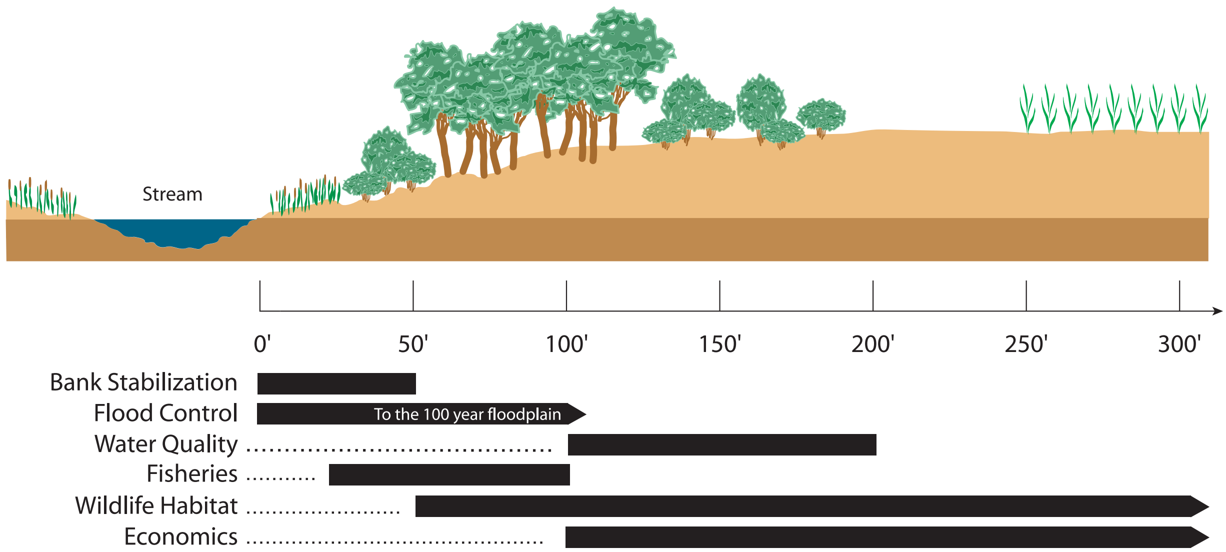

Figure 4. *Buffer strip recommendations based on resource protection goals (CRJC, 1998).*

Water Quality

A recent review of the scientific literature on riparian buffer strips concluded that for water quality protection, buffer strips should be a minimum of 100 feet wide under most circumstances, although buffers should be extended for steeper slopes (Wenger, 1999). This conclusion was based on several studies of different pollutants. As an example, to reduce nitrate concentrations 100-foot buffers were shown to provide good control, while 50-foot buffers were sufficient under many circumstances. Another review of the scientific literature identified the desired buffers for wetland protection (Castelle et. al., 1994). In this review, buffers less than 30 feet were determined to be inadequate under most conditions. Instead, buffers were recommended to be a minimum of 50 feet to 100 feet in width with the following caveat: buffers toward the lower end of this scale (50 feet) were deemed adequate for the "maintenance of the natural physical and chemical characteristics of aquatic resources;" and buffers at the upper end (100 feet) appeared to be "the minimum necessary for maintenance of the biological components of many wetlands and streams." Bozeman has adopted setbacks in their subdivision regulations based on providing "bank stabilization, sediment, nutrient and pollution removal and flood control." Their setbacks are 100 feet from the East Gallatin River, 75 feet from Sourdough and Bozeman Creeks, and 50 feet from all other watercourses (*see City of Bozeman, page 5-10*).

Flood and Erosion Control

Public and private investments in property are at risk of damage or loss if stream dynamics are ignored. Using vegetated buffers to set back human developments and land uses from stream banks is cost effective protection against the hazards caused by flooding, lakeshore erosion, and moving streams (CRJC, 1998). Smaller streams may require only a narrow buffer of trees or shrubs, while larger streams and rivers may require a buffer that covers a substantial portion of its floodplain. In areas where streams are known to meander, setbacks should incorporate floodplains, as well as non-floodplain areas overlooking the stream or river: a common problem arises when homes are built overlooking a river, as stream channels naturally move these homes can become vulnerable to falling into the water (*see Bank Stabilization and Land Use Planning, page 4-2*).

Economic and Community Values

Several Montana communities have decided that the conservation of rivers and streams is important to maintaining the rural character of their community's landscape. Choteau County has a 3-mile setback from the Missouri River in places where development would be visible from the river (*see Choteau County, page 5-7*). Madison County determined that a 500-foot setback was needed in its subdivision regulations in order to protect the Madison River corridor (*see Madison County, page 5-10*). Both of these areas rely on rivers for the local economy and quality of life. Larger buffers are needed when visual resources are identified as a key resource that warrants protection—particularly in Montana's intermountain valleys and plains where the state earns its "Big Sky" namesake.

Fish and Wildlife Habitat

In streams where temperature and recruitment of woody debris is important for fisheries, the scientific literature indicates that riparian forests should be preserved or restored for a minimum of 35 to 100 feet along streams. For wildlife, buffers must provide enough room for animals to take shelter, find food, successfully raise young, and hide from predators. While narrow buffers offer habitat benefits to many species, most wildlife—especially birds and larger mammals—depend upon riparian areas that are a *minimum* of 300 feet wide (Wenger, 1999) (*see Box VII*). As desirable as they may be, 300 or 600-foot wide buffers are not practical on all streams in most areas. One recommendation to accommodate this issue involves including at least a few wide (300 – 1,000 foot) riparian sections and large blocks of upland habitat along narrower protected corridors. Protection of these wide riparian corridors for wildlife could be a part of an overall habitat protection plan for a county.

Box VII. Recommended Buffers for Wildlife

Research shows that the following buffer widths are needed to support different species of wildlife (adapted from CRJC, 1998; bald eagle information from Montana Bald Eagle Working Group, 1991):

Wildlife dependent on wetlands or watercourses	Desired Width
Bald eagle	1,320 feet (1/4 mile)
Nesting heron, cavity nesting ducks	600 feet
Pileated woodpecker	450 feet
Beaver, dabbling ducks, mink	300 feet
Bobcat, red fox, fisher, otter, muskrat	330 feet
Amphibians and reptiles	100-330 feet
Belted kingfisher	100-200 feet
Songbirds (dependent upon species)	50-660 feet

Choosing a Buffer Type

There are three basic methods used to establish buffer size: using a fixed width buffer, a variable width buffer, or a blending of the two. The choice made about which method to use will depend upon time and financial resources available, levels of expertise required of staff, desired level of predictability in land use planning decisions, and other factors. This choice will also directly impact the width of buffers.

Fixed Width Buffers

In the fixed width system, a specific distance is chosen to protect the most desired functions, allowing local governments to literally use a tape measure to determine the size of buffer strips.

- **Riparian buffers** are most commonly established by measuring the setback from the ordinary high water mark of a watercourse. A definition of the ordinary high water mark appears in Box VIII. When no ordinary high water mark is discernible, setbacks are usually measured from the top of the stream bank.
- **Wetland buffers** are typically determined by measuring from the edge of a wetland's boundary. A discussion of determining wetland boundaries appears above (*see Delineated Wetlands, page 4-3*).

The advantages to fixed width buffers include that they do not require personnel with specialized knowledge of ecological principles, are more easily enforced, allow for greater regulatory predictability, and require smaller expenditures of both time and money to administer. The main disadvantage is that the buffer does not take into account site-specific conditions, and therefore may not adequately protect resources (Castelle et. al., 1994). Madison County uses a fixed width buffer system in its subdivision regulations for riparian setbacks (*see Madison County, page 5-10*).

Variable Width Buffers

Buffers can also be determined on a case-by-case basis. Based on site-specific conditions such as slope, vegetation, and intensity of land use, variable width buffers can be adjusted to adequately protect valuable resources. Since every stream, parcel of land, wetland, and land use is different, variable width buffers are better tailored to the land. While more science-based, a program depending upon variable width buffers requires more site evaluation and is more expensive and difficult to administer. It also requires a higher level of training for local government staff, while offering less predictability for landowners.

Missoula County has adopted a variable width buffer in their subdivision regulations for both wetlands and riparian areas (*see City of Missoula and Missoula County, page 5-10*). Under this system, the buffer size is determined from a list of plants typical of local wetlands and riparian areas, floodplain maps, and other factors. There are several challenges associated with this approach that need to be carefully considered:

- Vegetation may have been removed by human-caused activities; under these circumstances a lack of vegetation may not be a good indicator of buffer width.
- Riparian vegetation often does not exist on the bluffs overlooking a river. Under this circumstance, floodplains maps and a lack of vegetation are not good indicators of buffer width (*see Bank Stabilization and Land Use Planning, page 4-2*).
- Floodplains, even when they are delineated, may change in location as rivers and streams change their course.

The Blend – A Combination of Fixed Width and Variable Width Buffers

Many local governments have developed a successful program by blending fixed width and variable width buffers. Buffer size in this system begins with a standard width (e.g. 100 feet), and then expands or contracts based on specific criteria. In the case of riparian buffers, the common criteria used for expansion include the 100-year floodplain boundary, undevelopable steep slopes, and/or adjacent wetlands. For example, the City of Bozeman requires a minimum buffer of 100 feet on the East Gallatin

River. This setback must expand to include the delineated 100-year floodplain, adjacent wetlands, and steep slopes (*see City of Bozeman, page 5-10*). Similarly, a blended system for wetlands might establish a set buffer width, and then expand the size for steep slopes and impervious surfaces. The blended system allows buffers to reflect site-specific conditions, but minimizes the expense, time, and training required for administration of the program. It can also increase predictability in the land use planning process.

Box VIII. Useful Definitions for Riparian Buffers

The following are suggested definitions that can be incorporated into local regulations to establish riparian buffers:

Watercourse/Stream

Three definitions are given: the term *watercourse* includes intermittent streams; the term *stream* is restricted to perennial streams and rivers; and the term woody draw includes small intermittent and ephemeral streams (*see Riparian Areas, page 4-1*):

- ***Watercourse*** includes any stream, river, creek, drainage, waterway, gully, ravine, or wash in which water flows either continuously or intermittently and has a definite channel, bed and banks, and includes any area adjacent thereto subject to inundation by reason of overflow. The term watercourse shall not be construed to mean any facility created and used exclusively for the conveyance of irrigation water.

- ***Stream*** means any natural perennial-flowing stream or river, its bed, and its immediate banks except a stream or river that has been designated by (Conservation District) rule as not having significant aquatic and riparian attributes in need of protection or preservation under 75-7-102, MCA. (This definition is taken from the Natural Streambed and Land Preservation Act of 1975 that guides Conservation Districts regulations under the 310 law.)

- ***Woody draws*** are areas that support woody vegetation, such as tall shrub and tree species, in small intermittent and ephemeral drainages. The vegetation is a result of higher moisture availability than the surrounding area. The duration of surface water, however, is shorter than that of other streamside riparian areas (e.g. cottonwood and dogwood communities). (This definition is taken from subdivision regulations used by the City of Missoula and Missoula County (*see City of Missoula and Missoula County, page 5-10*). Grassy swales can be considered the eastern Montana (or drier prairie) corollary to woody draws.

Ordinary High Water Mark. The ordinary high water mark means the line that water impresses on land by covering it for sufficient periods to cause physical characteristics that distinguish the area below the line from the area above it. Characteristics of the area below the line include, when appropriate, but are not limited to deprivation of the soil of substantially all terrestrial vegetation and destruction of its agricultural vegetative value. A flood plain adjacent to surface waters is not considered to lie within the surface waters' high-water marks (23-2-301, MCA).

Consider Site Specific Factors

It is evident from this chapter that a range of variables influence the effectiveness of buffers. This section outlines the main site-specific factors that should be addressed in conservation programs that establish protective buffers.

Steep Slopes

From a water quality perspective, the most effective buffers are flat. Scientific research shows that the width of buffers should be increased when slopes are steeper to allow more opportunity for the buffer to capture pollutants. The greater the slope, the faster water flows over the surface. Many researchers have noted that very steep slopes cannot effectively remove contaminants, though there is debate over what constitutes a steep slope, with ranges suggested between 10% and 40%. One model recently proposed suggests that slopes over 25% should not count towards a buffer, and that the buffer should be increased in size by 2 feet per 1% increase in slope (Wenger, 1999). The City of Bozeman adopted a variation on this model (*see City of Bozeman, page 5-10*). Use of topographic maps and site visits will confirm the slopes contained within stream corridors.

Impervious surfaces

For vegetation to work efficiently, studies show that 80% of the buffer strip should be vegetated (Channing Kimball, 1993). Parking lots, compacted or paved roads and trails, and other impervious surfaces reduce the filtering capability of buffer areas, increase surface erosion, and lead to higher and faster storm flows in streams. In order to ensure that buffers are effective, local governments should consider limits on impervious surfaces. One model suggests that impervious surfaces should not count toward the buffer width. Using this recommendation, if a 30-foot wide road parallels a stream, the riparian buffer should be increased by 30 feet (Wegner, 1999).

Vegetation

The longer runoff is detained in the buffer before entering a stream or wetland, the better. Wetland and riparian vegetation increases the effectiveness of a buffer in several ways. Physically, roots trap sediments and their contaminants, hold banks in place, and prevent erosion. By providing a canopy, vegetation reduces the velocity of raindrops and lessens runoff and erosion. Trees, shrubs, and to a lesser extent grasses, provide habitat including cover for wildlife and fish, nesting sites, and food. Overhanging branches provide shade that reduces stream temperature. Litter (leaves and organic debris) from trees and shrubs provide food for aquatic organisms. Chemically and biologically, vegetation absorbs nutrients and pollutants such as chemical pesticides, salts, sediments, and organic wastes from entering our surface and ground water. Vegetation is factored into buffer strips through regulations that determine the types of activities allowed. Examples of common restrictions include:

- Minimizing removal of vegetation;
- Discouraging the cutting of existing trees and other vegetation on stream banks;
- Encouraging the planting of native vegetation over non-native plants (including lawns); and
- Prohibiting the use of pesticides and fertilizers.

Floodplains

Scientific studies show that protection of the entire floodplain of a stream or river provides significant contaminant removal and—naturally—minimizes damage from floods. For these reasons, it makes sense to extend the buffers to the edge of the floodplain whenever possible. Studies recommend that riparian buffers extend at least to the edge of the 100-year floodplain (Wenger, 1999).

Soils

Soils filter out sediment and pollutants. The speed by which materials percolate out depends upon the amount of organic material and the size of the spaces between the grains of soil. Soils are factored into buffer strips by regulating the types of activities allowed. In general, activities that compact soils or increase erosion (such as vegetation removal) should be avoided (Wenger, 1999).

Hydrology

Hydrology is the most important factor influencing the characteristics of a wetland or riparian area. Plants living in these areas are adapted to life in saturated soils, high water tables, or periods of flooding. The ground water level, time of year that the area is flooded, duration of a flood, range of water level fluctuations, and water flow rates, all play a vital role in the hydrology of these sites. Changes in any one of these factors may result in alterations of the resource. To secure long-term protection of wetlands, a water right may be needed. For riparian protection, streams should not be de-watered and periodic natural flooding should be allowed.

Land Uses

Buffer areas are more effective if their size can be tailored to the use of land adjacent to the buffer. When possible, local governments should suggest allowable uses, such as agriculture and forestry activities using best management practices; parks and recreation areas with minimal structural development; and non-motorized trails. Passive use of land for recreation and nature appreciation should be encouraged. The harvest of timber for firewood or commercial use, consistent with Montana's Streamside Management Zone law (*see Appendix IV*), may be allowed. Additionally, suggested prohibited uses should include: all uses that present a higher potential for pollution; campgrounds other than dispersed tenting sites (because of their tendency toward soil compaction and deforestation); motorized vehicles and mountain biking since these uses can contribute to vegetative loss and erosion; and construction of buildings or structures that do not depend on their proximity to water (CRJC, 1998).

An Example of a Buffer System

The following model of a buffer system was developed after an extensive literature review (Wenger, 1999). It was developed specifically to protect water quality in riparian areas. This model illustrates a practical yet effective system that can be used to build a program with buffers. It also illustrates how discussions from this chapter might evolve into on-the-ground protection for sensitive areas. Although this model was designed for riparian areas, many of the principals could easily be adapted to wetlands.

This model provides protection for water quality in stream corridors, including good control of sediment and other contaminants. The buffer applies to all perennial, intermittent, and ephemeral streams. The model begins with a base setback width of 100 feet, then adds or subtracts distance for the following elements:

- Adds 2 feet per 1% slope;
- Extends to edge of the 100-year floodplain; and
- Includes adjacent wetlands. The buffer width is extended by the width of the wetland, which guarantees that the entire wetland and an additional buffer are protected.
- Subtracts for existing impervious surfaces in the riparian zone. They do not count toward buffer width (i.e., the width is extended by the width of the impervious surface, just as for wetlands) .
- Subtracts for slopes over 25%. They do not count toward the width.

<u>Box IX. A Bigger Buffer is Needed If:</u>

- Land is sloped and runoff is directed toward the stream or wetland (the steeper the slope, the wider a buffer should be)
- Land use is intensive (crops, construction, development)
- Soils are erodible
- The land is floodplain
- The stream naturally meanders
- The land drains a large area
- Aesthetic or economic values need to be preserved
- Wildlife habitat needs to be protected
- More privacy is desired

(Adapted from CRJC, 1998)