Developer's Guide to the Riparian Setback Matrix Model For Use by the City of Grande Prairie

Prepared for:

The City of Grande Prairie

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Executive Summary

The following is a companion document to the recently-developed *Riparian Setback Matrix Model* as modified for the City of Grande Prairie for use on all water bodies within the City. The current document has been prepared to give an overview of model application for those working in the development industry. The Riparian Setback Matrix Model is used to establish unique environmental reserve setbacks to lakes, streams, brooks, creeks, wetlands and intermittent water drainage courses during the development process under authority of Part 17 of the *Municipal Government Act* to sustain watershed and/or watercourses in balance with developmental pressure.

For more details, you can request a copy of the *Riparian Setback Matrix Model* from the City of Grande Prairie Land Use Planning Department office by contacting:

Development Services Land Use Planning Department

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1 Introduction

Facing increasing development pressure, the need to protect and restore riparian areas within the City of Grande Prairie has become a requirement. Riparian areas are the areas of water-loving vegetation beside a stream, river, lake or pond. Riparian areas are critical to plant and animal communities and to reduce the negative effects of various land-uses on adjacent waters. The Riparian Setback Matrix Model (RSMM) was created to help prevent development impacts on surface water bodies. The model is an effective tool to establish adequate riparian buffer setbacks to aid in the protection of shorelines, water quality and riparian lands[1], while allowing for development to occur in a sustainable manner.

The purpose of this guide is to help those in the development industry to apply the RSMM (as modified for use in the City of Grande Prairie) in a stepwise manner and to identify those qualified professionals required to apply the model. This guide also reinforces the need for Environmental Reserve (ER) protection to maintain healthy and functional riparian areas for the purpose of preventing aquatic pollution[2], while providing public access that will not impede natural functions. The RSMM will be used by the City of Grande Prairie administration to determine and enforce appropriate Environmental Reserve setback dedications located adjacent to bodies of water, including lakes, streams, brooks, creeks and intermittent water inflows during the development process.

1.1 What is the Riparian Setback Matrix Model?

The RSMM is a scientifically-based, legally defensible model that allows municipalities to take adequate precautions to prevent the most common forms of pollution, instead of establishing arbitrary setbacks. This policy and procedure is applied under direction from the *Municipal Government Act* (Sections 663 and 664).To obtain the required information (slope, soil texture, groundwater influence and vegetation data) required for the RSMM, applicants will need to retain the services of a qualified professional, registered in the province of Alberta with an organization that is part of the Joint Environmental

[1] "Riparian land" means the lands adjacent to a watercourse where the vegetation and soils show evidence of being influenced by the presence of water. Riparian areas are the green zone around a watercourse. They are the vital transitional zone between surface water and the drier uplands and play a vital role in the healthy functioning of both. For the purposes of this model, riparian lands are taken to start at the bank or ordinary high water mark of a body of water.

[2] "Pollution" means any non-point source impacts on the environment from substances such as sediments, nutrients, pesticides, bacteria, parasites or toxic chemicals that reach a watercourse by surface or subsurface flow though adjacent land, and the unauthorized release of any "deleterious substance" as defined in the *Fisheries Act* (Canada), or the unauthorized release of any substance whether non-point or otherwise that may cause an adverse effect under provisions of the *Environmental Protection and Enhancement Act.*

Professional Practice Board[3] to undertake a geophysical assessment of the proposed development. Please see the section entitled "Professional Requirements for Site Assessments" for a guide to the types of professional affiliation that are required for different site conditions based on a cursory initial assessment.

[3] Includes Alberta Institute of Agrologists (AIA), Alberta Society of Professional Biologists (ASPB), Association of the Chemical Profession of Alberta (ACPA), Association of Professional Engineers and Geoscientists of Alberta (APEGA), Association of Science and Engineering Technology Professionals of Alberta (ASET), College of Alberta Professional Foresters (CAPF), and College of Alberta Professional Forest Technologists (CAPFT)

1.2 What is an Environmental Reserve?

An Environmental Reserve (ER) is a buffer of natural land that lies between developed/developable land and environmentally sensitive areas such as lakes, rivers, streams, creeks, and wetlands (Figure 1). During subdivision of a parcel of land, under conditions prescribed in the *Municipal Government Act*, a municipality can acquire "reserve lands". Environmental Reserve is "undevelopable" land that must be left in its natural state, or used as a public park or for public access to the area (Sec 671 MGA). The strip of land determined by the model will be dedicated to the City of Grande Prairie as Environmental Reserve (where the City takes ownership), or, placed under an Environmental Reserve Easement, at the discretion of the City. Under this latter form of protection, the City may specify additional conditions on the land, in addition to restricting development. The use of environmental reserve parcels for exclusive, private purposes is not permitted. As the owner of environmental reserve, the City of Grande Prairie has the responsibility to control access and use to ensure that these sensitive landscapes are sustained for current and future generations.

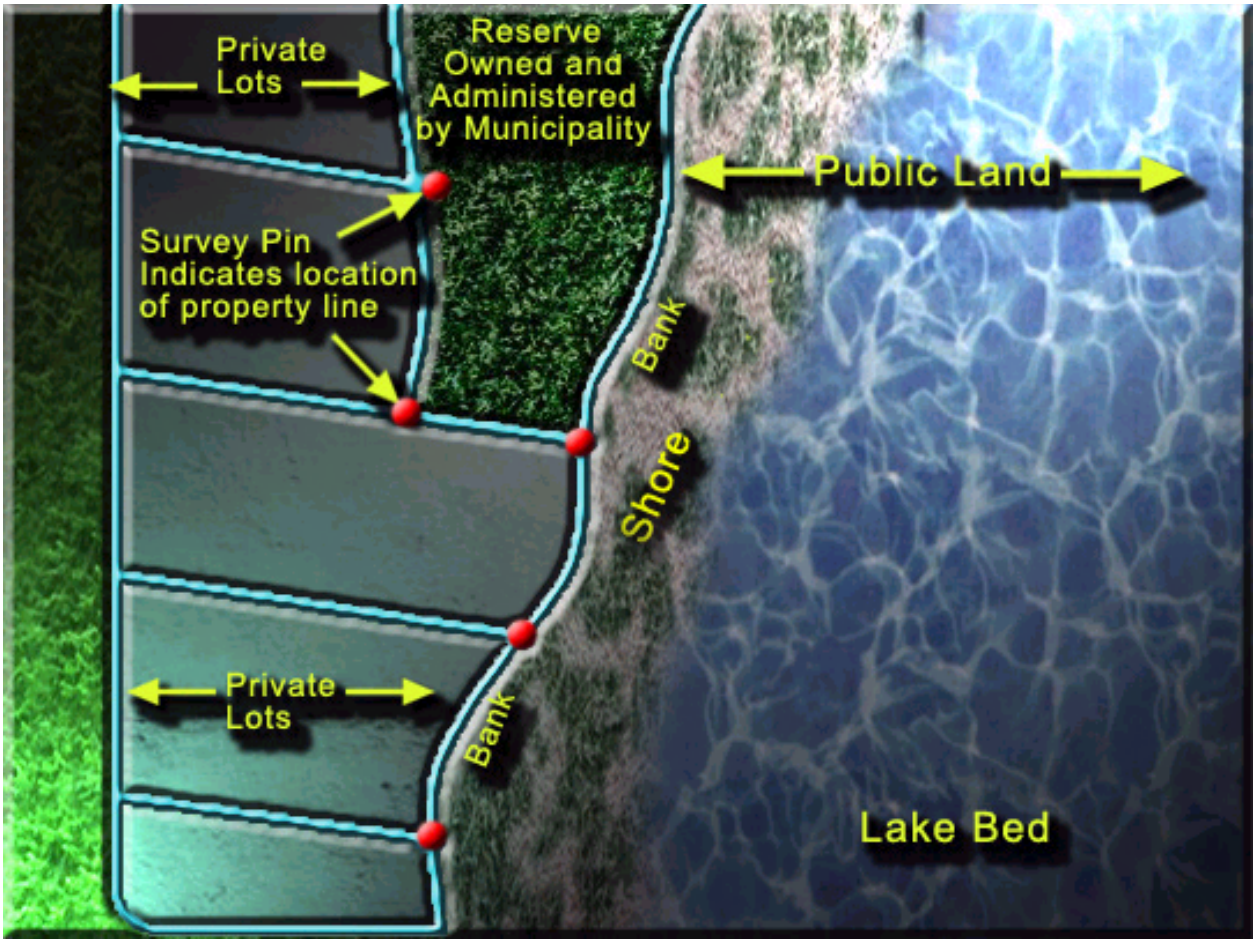


Figure 1. Illustration of lake bed and bank which is public land and owned by the Province and the Environmental Reserve land that is owned by the Municipality.

1.3 When do I need to dedicate reserve lands?

As stated in the *MGA*, a municipality can require the dedication of ER if the lands proposed for subdivision abut the bed and shore of any lake, river, stream or other body of water[4] (Figure 1). When such reserves are taken for the purposes of **preventing pollution** or **providing public access to or beside the bed and shore**, the reserve taken must be **not be less than 6 metres in width**, allowing that these objectives may require greater ER widths (Stewart, 2006). In addition, environmental reserves may also be taken on land that **consists of a swamp, gully, ravine, coulee or natural drainage course**, or **that is subject to flooding or is, in the opinion of the subdivision authority, unstable**. In the latter two cases, the reserves will comprise the entirety of these lands, and may be wider than the minimum 6 metres required for pollution prevention or access.

By preventing nutrients from entering a fresh water body, algal and aquatic vegetation growth is minimized. Other benefits of ER dedication include public access to the water body, wildlife attracting habitat as well as shoreline erosion prevention. When the RSMM is applied through zoning bylaws, there is no transfer of ownership, though development within the setback area can still be prevented through landowner education and the enforcement of the bylaw by the City.

The trend of residing in an urban subdivision in a rural setting is increasing nationally. As the population shifts to these desirable rural subdivisions, more pressure is placed on the environment. The Riparian Setback Matrix Model gives the community the ability to benefit from the environmental social and economic services of the land.

1.4 What is the purpose of an Environmental Reserve?

The strip of land abutting a lake or other watercourses are taken as ER for two purposes: to prevent pollution, or to provide public access to and beside the bed and shore. Environmental Reserve is dedicated to protect provincially owned beds and shores and the aquatic environment[5] from "pollution". Therefore, the definition of pollution that a municipality adopts constitutes pollution in their community. Nutrients are defined by the City of Grande Prairie as pollutants (as are other compounds such as suspended sediments, hydrocarbons, salts, and metals), and steps will be taken to protect aquatic systems from additional nutrients from making their way into watercourses via point and non-point source discharges. One of the most effective ways to protect aquatic ecosystems and prevent pollution is to ensure that riparian areas are intact, healthy and functional.

Sometimes, residents think that their property rights allow them to use adjacent ER parcels for exclusive, private purposes. They landscape, cut down trees, mow vegetation along streams, and plant

[4] "water body" means any location where water flows or is present, whether or not the flow or the presence of water is continuous, intermittent or occurs only during a flood, and includes but is not limited to wetlands and aquifers … *Water Act*, S1, RSA 2000

[5] (h) "aquatic environment" means the components of the earth related to, living in or located in or on water or the beds or shores of a water body, including but not limited to (i) all organic and inorganic matter, and (ii) living organisms and their habitat, including fish habitat, and their interacting natural systems. *Water Act*, S1 RSA2000

gardens outside their lot lines with invasive species of flowers, shrubberies and trees. ER shore lands are often fenced or barricaded or restricted against the natural flow of people and floodwaters even when ER strips lie between their property and the bed and shore of a river or lake.

People compete with wildlife for ER adjacent to rivers and lakes which act as wildlife corridors or migratory bird habitat, and provide shade, shelter, food and water for flora and fauna. Some citizens consider ER private playgrounds to walk dogs, cycle, and ride all-terrain vehicles. These activities create *ad hoc* pathway systems, adversely affecting the natural ground cover and vegetation, pollution, erosion of escarpments and ravines, and sedimentation of adjacent watercourses and bodies of water.

Riparian zones act as buffers and protect water quality. Contaminants are absorbed onto sediments, taken up by vegetation and transformed by soil microbes into less harmful forms. Defining a riparian area (riparian buffer strip) that is large enough to effectively protect the water and the aquatic ecosystem is necessary. Each water body requires unique set riparian buffer widths and development setbacks. It is essential that municipalities determine appropriate land uses adjacent to bodies of water, including wetlands, to avoid or minimize development impacts of our valuable water resources, as stated in the provincial and municipal *Land Use Bylaws*. The importance of identifying and protecting a properly-sized buffer strip is critical for source water protection.

1.5 How much land will be taken as an Environmental Reserve?

The RSMM seeks to balance the protection of the natural environment and the needs of developers, taking only the minimum setback or Environmental Reserve required to adequately protect aquatic environments from pollution. The Environmental Reserve created through this process will also provide other significant functions such as public access, but the determination of ER width under the RSMM is based only on requirements for pollution protection. Pollution can be defined as substances such as sediments, nutrients, pesticides, bacteria, parasites or toxic chemicals that reach a watercourse by surface or subsurface flow. Riparian areas reduce the amount of pollution reaching a watercourse. The reduction in pollution reaching the watercourse is highly correlated with the characteristics of the adjacent riparian lands, depending on the site characteristics such as slope, vegetation cover, soil and bank height.

The amount of land the City of Grande Prairie will require to be dedicated as Environmental Reserve will range from 10 - 90 metres. The amount of land required will vary with the changing slope, soil texture, groundwater risk, and vegetative cover present on the land. Setbacks are reduced in areas where conditions provide good protection for the aquatic environment and increased in areas where conditions provide poor protection for the aquatic environment.

Conditions	Protection of aquatic environment
low slopes, high cover of robust vegetation, low groundwater risk, and/or low soil erosion risk	Good
high slopes, little vegetation cover, high groundwater risk, and/or highly erodible soil	Poor

Additionally, the model for the City of Grande Prairie also takes into account the presence of **Environmentally Significant Areas**, determined from a variety but most notably landscape connectivity. In addition to providing improved protection of the aquatic environment from pollutants, contiguous natural habitats are valued for their aesthetic value and their roles in providing recreational usage and wildlife corridors.

1.6 Development Setbacks for Buildings

A municipality is responsible for the planning and development of private lands within its geographical boundaries. The *Municipal Government Act* requires municipalities to enact a Land use Bylaw[6], the provisions of which can be used to control the development of "buildings" **on land subject to flooding or subsidence or that is low lying, marshy or unstable**; or, **land adjacent to or within a specific distance of the bed and shore of any lake, river, stream or other body of water**. What constitutes a "building" is defined in the *MGA* to include all structures except highways and bridges. Controlling development of buildings within prescribed development setback areas can be done through policy statements and land use bylaw provisions. The opportunity to create appropriate development setbacks and land uses in riparian areas is underutilized by municipal governments. The RSMM presented here will assist the City of Grande Prairie to create a defensible "natural environmental reserve" land use designation with associated permitted and discretionary land uses. The natural riparian function of each landscape that a municipality wishes to preserve will determine the extent of the development setback required. The RSMM will assist municipalities to adopt appropriate development setback policy and enact appropriate Land Use Bylaw provisions inclusive of Area Structure Plans or Watershed Management Plans, integration of policies and directives.

1.7 Flood Plains and Flood Risk

The RSMM was designed with the aim of reducing pollution into bodies of water, per the *Municipal Government Act*[7]. It does not directly address issues such as flood plain instability, inundation, or flood frequency.

[6] MGA 640(1)
[7] MGA 640(1)(c)

2 Riparian Setback Matrix Model

The amount of ER taken by the City will be determined by using the Riparian Setback Matrix Model. Environmental Reserve will be determined at several sites starting at the transition to upland vegetation (i.e. upper edge of the riparian area). The area dedicated as Environmental Reserve will vary throughout the site as it follows this edge. Some areas will require wider Environmental Reserve and others will require much less, all based on site conditions. The Environmental Reserve will vary throughout the parcel of land depending on existing features: slope of the land, soil texture, groundwater influence and vegetative cover.

The RSMM is meant for all types of bodies of water in the City of Grande Prairie. Parameters or measurements that may lead to intervention or modification of the prescribed setbacks by municipal administrators are highlighted in yellow; parameters or measurements requiring special surveys or other technical considerations are highlighted in red. Parameters that may require special consideration include steep slope, impermeable surface cover, and extensive river meander or wide flood plains.

The model may be applied to either determine the width of Environmental Reserve that will be taken during the subdivision process, or to determine the setbacks required for the development of lands and the construction of new buildings.

Under the RSMM for the City of Grande Prairie, the baseline setbacks (determined from slope, vegetation cover, and groundwater table depth) fall within the range of 10 – 40 m. If soil conditions or Environmentally Significant Areas are present, these setbacks are subject to a multiplicative factor to increase protection to the aquatic environment. Under "worst case" conditions for the protection of the aquatic environment from pollution, the maximum setback is increased to 90 m (40 m baseline setback × 1.5 soil multiplier × 1.5 ESA multiplier).

2.1 How to use the Riparian Setback Matrix Model

The amount of property bordering the water's edge will also affect how riparian setbacks are determined. To start using the Riparian Setback Matrix, setback points will need to be established. The number of points used to determine riparian setbacks will vary based on the area to be developed and the length of shoreline present. At each setback point, each parameter in the model is measured or calculated (slope, groundwater risk, vegetation cover, and soil texture), and the overall setback is determined. For areas with more than one setback, the ER is determined by joining the individual setback points with straight lines (Figure 2).

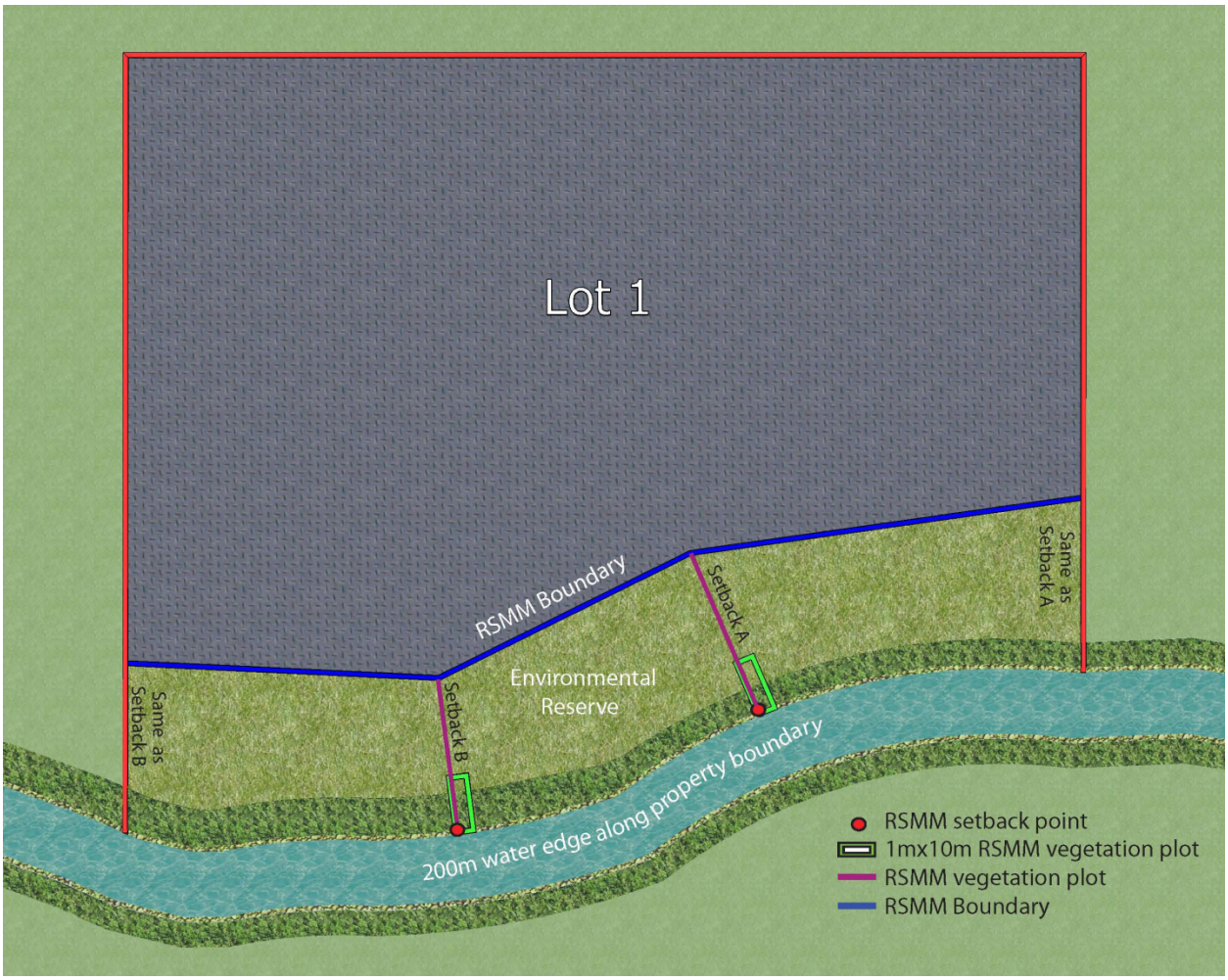


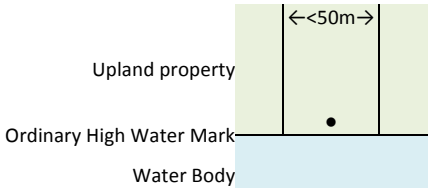
Figure 2. Schematic view of riparian setback determination at three points within a property.

2.1.1 Steps of the Riparian Setback Matrix Model

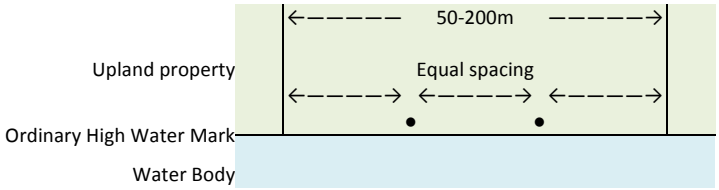
1. **Establish the number of setback points required**.

1.1. Whereas the length of land bordering the water body, stream or wetland is:

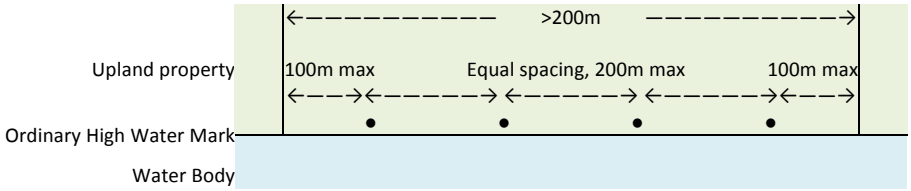
1.1.1. **Less than 50 metres –** One (1) setback point will be required at the discretion of the City of Grande Prairie. Please contact the City of Grande Prairie administration to determine the location of this setback point.



1.1.2. **200 metres to 50 metres –** Two (2) setback points will be required equal distance apart and equal distance from each end of the property, along the boundary between the property and the water body.



1.1.3. **Greater than 200 metres –** The outside setback points will be no more than 100 metres from each end of the property, along the boundary between the property and the water body. If the distance between these setback points is more than 200 metres, additional setback points will be required. These must be equally spaced from each other and the two outside setback points, and no more than 200 metres apart along the boundary between the property and water body.



2. **Establish the location setback points**

2.1. Whereas the location of the point will be:

2.1.1. At the boundary of the bed and shore between the private and crown-owned property (ordinary high water mark), as delineated by a legal land surveyor; or,

2.1.2. If the property has not been delineated by a legal land surveyor, the point where evidence of surface water influence on the soil ends and where vegetation (living or dead) characteristic of an aquatic environment (including but not limited to sedges, cattails, and bulrushes) end changes to that of upland vegetation; or,

2.1.3. If no vegetation exists, the point at the current edge of water.

3. **Vegetation Cover** for the site is determined based on a single 1 m x 10 m plot at each setback point:
   - 3.1. From each setback point, determine the vegetation type perpendicular to the water body, stream or wetland, by creating a 1 m x 10 m plot.
   - 3.2. Determine the percent of the plot that is herbaceous/graminoid, shrub, forested, impermeable and bare ground. Total cover must add up to 100 %.
   - 3.3. Multiply the percentage of each vegetation cover class by the respective distance adjustment for each type.
   - 3.4. Put the required adjusted distance beside the respective vegetation cover.
   - 3.5. Add up the setback requirements from all vegetation cover types to obtain the total vegetation cover setback.

EXAMPLE: Plot at is covered by 20% herb/graminoid, 30% shrubs, 40% forested and 10% bare ground.

Herb/graminoid (20 x 0.30) = 6.0 m
Shrub (30 x 0.20) = 6.0 m
Forested (40 x 0.10) = 4.0 m
Bare ground (10 x 0.40) = 4.0 m
TOTAL Vegetation Setback = 20 m

4. **Slope of the land** must be determined by a geotechnical engineer at each of the setback points. From each setback point, determine the slope of the land perpendicular to the water body, stream or wetland. The base setback distance for slope is calculated as follows:
   - 4.1. The minimum setback distance based on slope is 10 m.
   - 4.2. For slopes in the range of **0 to 15 %,** the setback distance will be 10 m + 1.5 m for every 1 % slope.
   - 4.3. If the slope is **>15 %,** then a geotechnical survey is required for the site. The total setback required for this site will be determined by a registered professional. The determined setback must take into account the slope, height of bank, groundwater influence, soil type and vegetative cover, and must be no less than the setback calculated based on the other parameters in the RSMM. Setback requirements will be subject to the approval of the subdivision authority.
   - 4.4. Record slope, under measured slope in Step 2 and enter the calculated distance adjustment in the TOTAL box in Step 2.

EXAMPLE: If your slope is equal to 12%: it falls in the 0 – 15 % category. The setback distance will be 10 m + 18 m for the 1.5 m per slope % (1.5 m x 12 = 18 m). Your total baseline setback for slope is 28 m.

5. **Groundwater table depth** is determined from nearby water wells/boreholes:

5.1. If boreholes or wells have been drilled on the property for geotechnical investigations or domestic water supply use, the static water level from the closest well shall be used as the depth to the water table.

5.2. Otherwise, water table depths will be determined from the nearest wells with static water level information available from the Alberta Groundwater Well Information Database will be used. If multiple wells at the same nearest location have static water level information available, the shallowest depth will be used.

5.3. Put a check mark next to the appropriate groundwater depth in Step 3.

5.4. Identify and enter the required distance adjustment in the TOTAL box in Step 3.

6. **Determine the baseline setback** based on slope, groundwater risk and vegetation cover.

6.1. If any of the setbacks calculated from steps 3 – 5 are equal to 40 m, the baseline setback for that point is 40 m.

6.2. Otherwise, the baseline setback is the maximum of the setbacks determined in steps 3 - 5.

7. **Soil type and texture** for the site is determined from soil samples or cores.

7.1. The soil type and texture is determined from the AGRASID soils information database.

7.2. Use the type (peat or mineral soil) and texture category (clay, sand, or silt soils) of the soil at the location to determine the setback soil multiplier.

EXAMPLE: If your soil type is high in clay (clay, silty clay, or sandy clay), it has a coefficient of 1.15. Write this number under the soil texture coefficient column. You will use this coefficient number in step9.

8. **Environmentally Significant Areas** on the property are determined based on the maps and report from O2 Planning + Design (2012).

8.1. If an ESA exists adjacent to the body of water anywhere within the boundaries of the property in question, the setback ESA multiplier is determined based on the significance ranking of the ESA in question.

EXAMPLE: If the setback point falls within an ESA of highest ranking, it has a coefficient of 1.5. Write this number under the Environmentally Significant Area coefficient column. You will use this coefficient number in step 9.

9. Multiply the distance obtained in step 6 by the soil multiplier determined in step 7, and multiply this result by the ESA multiplier determined in step 8. This is the final setback for the site.

EXAMPLE: If the baseline setback you obtained from Step 6 28 m, on clay soils with a highest-ranking Environmentally Significant Area present, you would multiply 28 by 1.15 (soil coefficient), and multiply this result by 1.5 (ESA coefficient).28 m x 1.15 x 1.5 = 48.3 m. Your setback at this setback point is 48 m.

10. **To establish riparian setbacks**, determine setback distances from each setback point. Connect setback points. Setback sat the property line will be set at the same distance from the body of water as the nearest determined setback point.

2.2 Riparian Setback Matrix Model Field Sheet

Water Body Name: _____

Location (1/4 – Sec – Rng – Twp – Mer): _____

Setback point location (UTM Coordinates): _____

Land Owner: _____

Field Personnel: _____

Date and Time:

1. VEGETATION			
Cover Type (% cover)	**Coefficients**	**Vegetation cover (%)**	**Baseline Setback (calculate)**
Forest	0.10		
Shrub	0.20		
Herb/graminoid	0.30		
Bare ground	0.40		
Impermeable*	0.40		
TOTAL			
2. SLOPE SETBACK			
Slope Category (%)	**Coefficients**	**Measured slope (%):**	**Baseline Setback (calculate)**
0 - 15%	10 m + 1.5 m / %		
>15%	geotechnical survey**		
TOTAL			
3. GROUNDWATER RISK			
Groundwater depth	**Coefficients**	**Check one:**	**Baseline Setback**
>20 m	10	◯	
10 – 20 m	25	◯	
<10 m	40	◯	
TOTAL			
4. SOIL SETBACK			
Soil Texture* **	**Coefficients**	**Check one:**	**Soil Texture Coefficient**
Peat	1.00	◯	
Clayey soils	1.10	◯	
Sandy soils	1.25	◯	
Silty soils	1.50	◯	
TOTAL			
4. ESA SETBACK			
Environmentally Significant Area Rank	**Coefficients**	**Check one:**	**ESA Coefficient**
None	1.00	◯	
Moderate	1.10	◯	
High	1.25	◯	
Highest	1.50	◯	
TOTAL			
OVERALL SETBACK			**Overall Setback (calculate)**
Baseline Setback	Largest from #1-3:	a)	
Soil texture coefficient	Value from #4:	b)	
ESA coefficient	Value from #4:	c)	
Total Setback		**Multiply a through c:**	

* - If impermeable surfaces are present, the setback distance must be increased by the width of the impervious surfaces encountered.

** - In cases where the slope exceeds 15%, a geotechnical survey must be conducted to ensure that the calculated setback protects potentially unstable lands

*** - Peat soils are defined for these purposes as having a minimum 50% soil organic matter, highly organic mineral soils are defined for these purposes as having more than 5% soil organic matter, regardless of sand, silt, or clay content; clayey soils include clay, silty clay, and sandy clay; sandy soils include sand, loamy sand, sandy loam, and sandy clay loam; and silty soils include silt, silty loam, loam, silty clay loam, and clay loam.

2.3 Professional Requirements

Although every effort has been made to make the RSMM accessible to as wide an audience as possible, the determination of setbacks should not be undertaken without enlisting the assistance of a professional(s) with qualifications appropriate for the conditions and complexity of the site (Table 1).

Table 1. Professional requirements for site assessments

Condition	Professional Requirements for setback determination
Low slope, obvious transition from aquatic to upland vegetation, groundwater table known from nearby wells	Professional biologist
Complex vegetation communities with no obvious transition from aquatic to upland vegetation	Qualified Aquatic Environmental Specialist (QAES) or Qualified Wetland Aquatic Environment Specialist (QWAES)
Moderate slopes (5-15 %)	Professional biologist + Geotechnical engineer
Steep slopes (>15 %)	Professional biologist + Geotechnical engineer
Extensive river meander* or presence of flood plain	QAES/QWAES + Geotechnical professional
Unknown water table depth	Hydrogeologist

* - The turns in a river associated with meander result in large, potentially overlapping riparian setback areas. Meander often indicates bank instability, channels that vary in position from year to year, and generally results in a larger area than would otherwise be expected being incorporated into riparian areas. The model as currently formulated is not designed to handle this case, and requires a geotechnical assessment of bank/channel stability, and a QAES/QWAES assessment to determine the long-term/historical high water marks and extent of riparian vegetation.

3 Vegetation Definitions

TERM	DEFINITION
Aquatic Vegetation	Plants that grow in water or in saturated soils (i.e. bulrushes, sedges, cattails, rushes, willows).
Bare Ground/Cleared	An area where the soil is exposed. There may be sporadically occurring plants present, especially weedy or colonizing species.
Forest	An area with a canopy created by one or more woody-stemmed trees with an average height of at least 2 m and an associated understory
Herbaceous	An area with cover provided by plant species without woody above-ground structures. Includes both graminoids (such as grasses, sedges, and rushes) and forbs (leafy plants).
Impermeable	An area devoid of vegetation with the ground surface covered with a substance that prevents the infiltration of water, such as concrete or asphalt
Shrub	An area with a canopy of woody or semi-woody plants with low stature (<2m), often though not always producing several basal shoots instead of a single trunk. Tree seedlings (saplings) <2m will also be considered as shrubs for the purposes of the model.