TECHNICAL NOTE

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USERS GUIDE TO DESCRIPTION, PROPAGATION AND ESTABLISHMENT OF NATIVE SHRUBS AND TREES FOR RIPARIAN AREAS IN THE INTERMOUNTAIN WEST

(Drawing by G. Bentrup)

Bebb Willow
Salix bebbiana

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Plant Materials Program

USERS GUIDE TO
DESCRIPTION, PROPAGATION AND ESTABLISHMENT
OF NATIVE SHRUBS AND TREES
FOR RIPARIAN AREAS
IN THE INTERMOUNTAIN WEST

INTRODUCTION

Establishment of riparian plant species depends on proper selection of species, plant material procurement and handling, planting location, and establishment techniques (Hoag 1993). The success of a project is dependent on the complete integration of these steps. When planning a project, it is important to observe the existing vegetation and their respective locations in relationship to the stream and water table (Figure 1). Attempt to match the potential native woody species at the project site. Note that not all riparian sites will have woody species (i.e. low gradient meadow streams). If the project area does not have woody plant species and it should, a reference site similar to the project site should be located. Attempt to match as close as possible the hydrology where the different species normally grow when planting the project site. This is the biological benchmark one is striving to create.

Plants with flexible stems and rhizomatous root systems are usually located from the top of the toe zone through the bank zone. Small to medium shrubs are found in the bank and overbank zones and beyond. Large shrub species and tree species are usually found in the transitional zone and the upland zone. They should not be planted in the other zones because of their large stems. These large stems do not give when high velocity stream flows hit them. In addition, the large stems tend to block debris and ice that can cause significant bank erosion. Wetland herbaceous species can be found throughout the streambank cross section, although most emergent aquatics will be found in the toe zone (Bentrup and Hoag, 1998). See Appendix A and B for charts that list plant characteristics for a variety of woody riparian plants from this region.

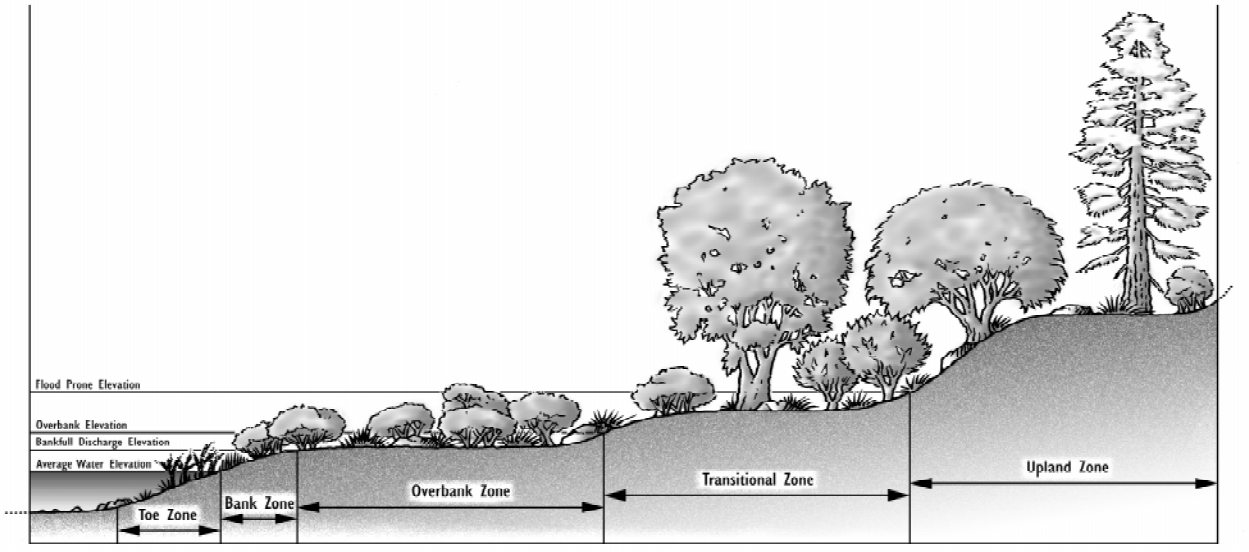

Figure1: Riparian Planting Zones can be used to determine where riparian species should be planted in relation to the waterline. This is a general depiction of a riparian zone. Not all streams look like this one. In the real world, some of these zones may be absent.

SPECIES DESCRIPTIONS AND PROPAGATION TECHNIQUES

The following information describes riparian woody plant species, their typical habitat, greenhouse propagation methods, and field propagation methods. Greenhouse propagation methods are procedures that can be used to produce bareroot or containerized plants. These procedures generally require greenhouse space, greenhouse equipment and supplies, some greenhouse propagation skill, and adequate time to grow the plants before transferring to your project location. Field propagation methods are procedures for planting unrooted dormant hardwood cuttings, literally branch or stems, into the various riparian planting zones. Unrooted cuttings are easy to plant, inexpensive, easy to collect, and capable of being planted deep enough to reach the low water level of the year. They can withstand high water velocities associated with seasonal out of bank flows. Not all woody plant species can be propagated from unrooted cuttings. Unrooted cuttings will have a lower survival rate, but are less expensive when compared to bareroot or containerized stock.

Dormant unrooted hardwood cuttings can be taken after leaf fall and before bud burst in the spring. The best rooting success is from cuttings that are 2-10 years old. The cutting diameter should be as large as possible depending upon species. The best diameters are 1.9-7.6 cm (0.75 to 3 in). The cutting should be long enough to reach 20-30 cm (8-12 in) into the lowest water level of the year. The top 2 feet of the cutting should be removed to provide higher energy to the auxiliary buds, i.e. root buds. All side branches should be removed to ensure that the stored energy is not expended to supporting branches or reproductive materials, but rather to grow roots. Willows have root primordia up and down the entire stem so roots will grow not only at the nodes, but also out of the internodes. Cuttings should be soaked in water long enough (commonly 5-7 days) to allow the buds to swell. Do not allow the roots to emerge from the bark. Hormone applications are not necessary for large volume plantings. Hormones may be used and valuable for cuttings older than 10-12 years or cuttings that have thick rough bark.

ALDER, RED - *Alnus rubra*:
A rapidly growing tree up to 25 m (80 ft) tall; bark is thin, smooth and often appearing white mottled due to crutose lichens; pith and cambium in stems turns rusty color when freshly cut; roots nitrogen fixing; leaves alternate, deciduous, shiny dark green above, lighter below with rusty pubescence along veins on underside, double serrated; flowers catkins; fruit winged nutlet in semi-woody small cone. Habitat is slightly moist to wet soils at lower elevations. Harvest ripe seed in September and October; air dry to prevent molding; short term storage by refrigeration, long term storage at less than 10 percent moisture content and freezer-stored in moisture-proof containers at -12° to -13°C (10.4 to 8.6°F) for up to 5 years without loss of viability. Fresh seed sown in the fall readily germinates, do not cover the seed, adequate water and a low nitrogen, high phosphorus fertilizer enhances germination and growth. Transplant seedlings at one to two years old. **Greenhouse asexual propagation** by softwood cuttings from young trees (< 7 years old), 6 to 12 cm (2.4 to 4.7 in) long, 2 to 4 mm (0.08 to 0.16 inch) in diameter, treat with approximately 3,000 ppm indole-3-butyric acid (IBA), media of 1:1, perlite:vermiculite at 25°C (77°F); transplant to a 1:1:1, vermiculite:perlite:sandy loam soil; leave in greenhouse for five weeks at 21°C (70°F) days and 15°C (59°F) nights; Outplant the following year. **Field propagation** by dormant unrooted hardwood cuttings is rare. Small seedlings can be collected from under mature trees and potted in containers for eventual reestablishment in riparian zones.

ALDER, SITKA - *Alnus viridis*:
A multiple stemmed shrub up to 3 m (10 ft) tall; bark is thin, smooth, reddish brown aging to grayish-green; stems are somewhat three-sided with triangular pith; roots nitrogen fixing; leaves alternate, deciduous, shiny green, double serrate with fine sharp teeth and sticky when young; flowers catkins; fruit winged nutlet in semi-woody small cone. Habitat is moist montane woods and streambanks at mid to lower elevations on coarse textured soils. Collect seed in the fall from trees at least 4 to 7 years of age; fall collected and sown seed readily germinates; stored seed requires a cold stratification period of 1 to 3 months at 3°C (37°F); fungicide powders prevent molding but may reduce germination percentage. Transplant seedlings at one to two years of age into a well-drained media with frequent watering and ample sunlight. **Greenhouse asexual propagation** and **Field propagation** of dormant unrooted hardwood cuttings is generally not successful.

ALDER, THINLEAF - *Alnus incana spp. tenuifolia*:
A large shrub up to 12 m (40 ft) tall; bark is thin, smooth, dirty green-gray and tends to flake when older; stems are somewhat threesided, sometimes with short rusty hairs, and pith turns rusty color when freshly cut; roots are nitrogen fixing; leaves are alternate, deciduous, dull green on both sides and yellow-green on central vein, not sticky, with double dentate margins; flowers catkins; fruit winged nutlet in semi-woody small cone. Habitat is moist montane woods and streambanks at mid to lower elevations on coarse textured soils. Collect seed in September through November; irregular crops every 1 to 4 years; fresh seed germinates without cold stratification; fall collected and sown seed germinates readily; air-dried seed can be stored in sealed containers at 1 to 3°C (34 to 37°F) for up to ten years; dried/stored seed requires a 180 day cold stratification at 5°C (41°F) before germination will occur. Transplant seedlings at one to two years old. Little information is available on asexual propagation but the tendency for this species to form adventitious roots when submerged in water suggests it is possible. **Greenhouse asexual propagation** - June and July softwood cuttings treated with 8,000 ppm IBA is generally recommended for Alnus species. **Field propagation** by dormant unrooted hardwood cuttings is very difficult. It has been reported that dormant unrooted hardwood cuttings will root if they are placed in soil that has been collected from under mature alder. The theory is that the microbes will cause the cuttings to root. In addition, small seedlings can be collected from under mature trees and potted in containers for eventual reestablishment in riparian zones.

ASPEN, QUAKING - *Populus tremuloides*:
A small to medium tree to 25 m (80 ft) tall forming dense colonies; bark is smooth, greenish-white to cream colored becoming blackish and rough with injury and age; leaves are alternate, deciduous, almost round, finely toothed, shiny yellow-green above and pale below becoming bright yellow to orange in fall, the laterally flattened petiole allows leaf to flutter in the slightest breeze; flowers catkins. Habitat is streams, moist benches and mountain slopes at low to high elevations on sandy to loamy soils. Susceptible to canker and fire, but readily suckers. Domestic livestock and wildlife readily graze younger growth. Collect seed from late May to mid June, collection is improved by pruning branches containing female catkins and then placing the cut ends in water under greenhouse conditions with low relative humidity to encourage ripening. Storage information is contradictory, one reference indicates that seed dried for three days at 24°C (75°F) will remain viable for one year if stored at 5°C (41°F) at a moisture content of 5 to 8 percent; another indicates that "dry" storage of seed for as little as two months results in dramatic drops in germination percentage. Surface sow seed on a water-saturated media; seed readily germinates in the spring. **Greenhouse asexual propagation** by root divisions (of suckers) and by lateral root propagation; root cuttings are collected in the dormant stage (spring or fall), 1 to 2 cm (0.4 to 0.8 inch) in diameter and 2.5 cm (1 inch) long; plant 1 to 3 cm (0.4 to 1.2 inch) deep in vermiculite under

greenhouse conditions for 6 weeks, separate suckers and plant in a 1:1 vermiculite:perlite mix under mist until rooting occurs. Pot up to larger sizes in a peat:vermiculite mix and grow under greenhouse conditions prior to hardening-off. **Field propagation** by dormant unrooted hardwood cuttings is rare. Root cuttings at least 13-15 cm (5–6 in) long with 1-2 stems about 1.2-1.8 m (4-6 ft) high have been moderately successful when planted in slightly moist soils.

BOXELDER - *Acer negundo*:
A small to medium tree to 20 m (65 ft) tall often with an irregular shape; bark is light brown to gray, thin on younger trees thickening with age, deep furrowed with broad rounded ridges; branches are stout, widely spreading to upright; leaves are opposite, deciduous, pinnately compound with 3 to rarely 5 leaflets per leaf, pointed tipped, often broad uneven base, coarse teeth along margins, light green above and paler and hairy below; flowers calyx females, stamen males on separate trees; fruits in hanging clusters, two winged. Habitat is lowland sites along streams, rivers, ponds, or flooded flats on a variety of soils. Tolerant of prolonged flooding. Seed requires both a pretreatment and a cold stratification period to break dormancy; northern sources have a shorter cold stratification requirement than southern sources. Pretreatment involves two weeks of soaking in cold water or a physical rupturing or removal of the pericarp prior to cold stratification; recommendations vary from 21 days at 20°C in sand or peat medium up to 2 - 3 months at 4°C (40°F). A high percentage of empty seeds can be expected. Transplant seedlings at one to two years old. **Greenhouse asexual propagation** of softwood stem cuttings works well when the cuttings are treated with 8,000 ppm IBA talc and can be taken up until mid September. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful.

BIRCH, WATER (BLACK) - *Betula occidentalis*:
A small tree or large shrub up to 10 m (30 ft) tall frequently found in crowded dense thickets; bark is thin, smooth, with horizontal pores, almost black on young trees, turning reddish-brown with age; branches are slender, upright, covered with numerous glands (small bumps); leaves are alternate, deciduous, with rounded wedge shaped base and pointed tip, entire near base extending to double row of fine sharp-pointed teeth, dark greenish-yellow and shiny above, paler and gland dotted below, sometimes tufts of hair at junctions of veins; flower catkins male and female same tree; fruit tiny winged seed in hanging or spreading small cone. Habitat is along rivers, streams, springs and moist locations at mid elevations on a variety of gravelly, cobbly to medium textured soils. Sow fresh seed in late summer to fall or prechill seed for 21 days at 20 to 30°C and sow in spring. Press seed into soil or very lightly cover with soil (sunlight is very important in the propagation process). Transplant young seedlings at one to two years old. Seedlings require shade during summer. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful.

BUFFALOBERRY, SILVER - *Shepherdia argentea*:
A spreading shrub occasionally forming thickets to 5 m (16 ft) tall; bark is dull gray, thin, smooth when young becoming somewhat ridged and shredding when older; branches are short, stout and younger stems are covered with dense, silvery-white scales; leaves are opposite, simple, widest near the middle, rounded at base and tip, leathery and covered on both sides with dense silvery scales; flowers, male and female on separate plants, male flowers in small clusters and female flowers on short stalks both near the tip of branchlets; fruit is produced singly or in clusters, round, somewhat fleshy, smooth, bright red and enclosing an egg-shaped, flattened seed. Habitat is generally seasonally wet, well-drained alluvial floodplains near rivers and streams on sandy to coarse texture soils. It is tolerant of some flooding, but is intolerant of prolonged flooding and permanent high water tables. Both hard seed coats and embryo dormancy occur requiring 20 to 30 minutes of acid scarification followed by 60 to 90 days of cold stratification at 20° to 30°C (68 to

86°F). Seeds should be planted at 0.6 cm (0.25 inch). **Greenhouse asexual propagation** information is very limited. Softwood cuttings taken in July and treated with 8,000 ppm IBA may prove successful based on results with related species. Successful seedling percentage is about 50 percent. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful. Root cuttings can be taken and planted without treatment with fair success.

CHOKECHERRY - *Prunus virginiana*:
A shrub or small tree to 8 m (26 ft) with irregular rounded crown and often crooked trunk; bark is thick, smooth to shallowly fissured, and dark reddish-brown to grayish-brown; branches are small, erect to spreading with shiny bark; leaves alternate, simple, deciduous, broadest near base, tapering to a pointed tip with fine sharply toothed margins, dark green above and light green below; flowers produced in elongated white clusters; fruit is rounded, red to black, shinny, thick skinned, juicy enclosing an egg shaped seed. Habitat is generally along riparian areas, moist slopes and it is most common on well drained, older, more developed sandy to silty soils that afford good rooting depth and high fertility. It can tolerate weakly saline soils, but is not tolerant of poor drainage or prolonged flooding. It is a very important food plant for many wildlife species. Collect seed in mid-August to mid-September; store clean, air-dried seed in sealed containers at 1°C (34°F) for up to 5 years; cold stratification at 5°C (41°F) for 120 to 160 days is recommended; Prechilling seed for 3 months at 20 to 30°C is recommended; seed can be sown outdoors in the fall or spring to a depth of 1.3 cm (0.5 inch) in a moist, well drained media; heavy or poorly drained soils increase the risk of disease losses. **Greenhouse asexual propagation** by softwood cuttings taken in the spring or early summer, treat with rooting hormones and provide bottom heat under greenhouse conditions. Transplant seedlings at one to two years age. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful. Root cuttings have had limited success.

CINQUEFOIL, SHRUBBY - *Pentaphylloides floribunda*:
A small shrub generally 0.25 to 0.75 m (1 to 2.5 ft) tall; branches with brownish shredding bark and hairy young twigs; leaves are leathery, pinnate with 3-7 leaflets, silky above and silky to whitish or greenish below; flowers yellow, axillary in small loose cymes. Habitat is generally moist early and dry later in the growing season in open valleys from mid to high elevations. Soils vary from clay loams to sandy loams and are fairly well developed with neutral to slightly acid pH. Seed matures from July through September, dry seed stored at 1 to 5°C (34 to 41°F) is said to retain viability for up to 5 years; seed will generally germinate well without pretreatment, although some recommendations include a 60 day cold stratification at 1°C (34°F). **Greenhouse asexual propagation** is by softwood cuttings taken in July and treated with 1,000 ppm IBA, in a 1:1, peat:perlite or sand media under mist greenhouse conditions; rooting occurs in 3 to 4 weeks; reduce watering once the cuttings have rooted. Transplant seedlings at one to two years of age. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful.

COTTONWOOD, BLACK - *Populus balsamifera spp. trichocarpa*:
A medium to tall tree to 50 m (165 ft) with a narrow, rounded open to pointed crown and straight trunk; bark is smooth, thin, yellowish-gray when young and turning dark grayish-brown, thick, deeply and sharply furrowed with scaly ridges; branches are erect reddish-brown and marked by orange pores when young, turning dark gray and roughened by leaf scars with age; leaves are alternate, deciduous, simple, broadest near rounded or wedge shaped base, pointed at tip, finely toothed, thick, leathery, dark green and smooth above and pale green or silvery white below with rust colored spots; flowers, male and female on separate trees, males dense catkins, females loose catkins; fruit, many three-parted hairy capsules in catkins containing numerous hairy seeds. Habitat is typically mineral soil over gravel and cobble and sites are commonly flooded in spring with

watertable dropping below 40 in later in growing season. These sites are typically excessively drained with low waterholding capabilities that allow rapid movement of highly aerated groundwater. **Greenhouse asexual propagation** by seed is difficult because the seed is very small and short-lived (most references indicated the seed is viable for 24-48 hours). Planting by seed requires surface broadcasting with no cover and extended surface moisture to ensure seedlings do not dry out. **Field propagation** of this species is relatively easily. They can be propagated with dormant unrooted hardwood cuttings. Ensure the base is placed into permanent moist zone. Recommendations are that the cutting be long and tapering. Cut off the top 0.6-0.94 m (2-3 ft) to enhance rooting. Remove by rubbing with a glove all but the top 4-5 buds. This will result in tree-like growth rather than shrub-like growth.

COTTONWOOD, FREMONT'S - *Populus fremomtii*:
A medium to tall tree to 30 m (100 ft) with broad, open crown and short trunk; bark is thick, smooth on younger trees, turning rough, and splitting with age, light gray to brownish to white; branches are stout and spreading, light green and smooth when young and turning yellow-gray with roughened leaf scars with age; leaves are alternate, deciduous, simple, triangular, with a very broad base and tapering tip, irregularly toothed, thick and firm, coated with hairs when young and light yellowish-green; flowers, male dense catkins, female loose catkins; fruit, 3-4 parted egg-shaped capsules in catkins containing light brown seeds covered with silky hairs. Habitat, southwestern tree found in mid to low elevations on moist soils near streams, rivers and ponds. This species does well in saline areas. **Greenhouse asexual propagation** by seed is difficult because the seed is very small and short-lived (most references indicated the seed is viable for 24-48 hours). Planting by seed requires surface broadcasting with no cover and extended surface moisture to ensure seedlings do not dry out. **Field propagation** of this species is more difficult then other cottonwoods possibly because of different cambial thickness and/or bark properties. They can be propagated with dormant unrooted hardwood cuttings. Ensure the base is placed into permanent moist zone. Recommendations are that the cutting be long and tapering. Cut off the top 0.6-0.94 m (2-3 ft) to enhance rooting. Remove by rubbing with a glove all but the top 4-5 buds. This will result in tree-like growth rather than shrub-like growth.

COTTONWOOD, NARROWLEAF - *Populus angustifolia*:
A small to medium tree to 18 m (60 ft) tall with a narrow cone shaped crown; bark is smooth, thin, yellowish-green when young becoming thicker at base of older trees and shallowly fissured with broad flat ridges; branches are strong, slender, upright, yellowish-green when young becoming bright to dark orange by fall and turning pale-gray in subsequent years; leaves are alternate, deciduous, simple, lance shaped, broadest near middle, tapering to pointed tip, fine toothed along edges, thin and papery, bright yellow-green above and paler below; flowers, male and females on separate trees in dense catkins; fruit is a two part egg-shaped capsule containing hair brown seeds. Habitat is generally at mid elevations along streams with large amount of coarse substrates such as gravel and cobbles where watertable commonly drops below 40 in later in the growing season. These sites are commonly flooded in spring and are typically excessively drained with low waterholding capabilities that allow rapid movement of highly aerated groundwater. **Greenhouse asexual propagation** by seed is difficult because the seed is very small and short-lived (most references indicated the seed is viable for 24-48 hours). Planting by seed requires surface broadcasting with no cover and extended surface moisture to ensure seedlings do not dry out. **Field propagation** of this species is relatively easily. They can be propagated with dormant unrooted hardwood cuttings. Ensure the base is placed into permanent moist zone. Recommendations are that the cutting be long and tapering. Cut off the top 0.6-0.94 m (2-3 ft) to enhance rooting.

Remove by rubbing with a glove all but the top 4-5 buds. This will result in tree-like growth rather than shrub-like growth.

CURRENT, GOLDEN - *Ribes aureum*:
An erect to rounded shrub to 2-3 m (6-10 ft) tall; stems are reddish, glabrous to finely hairy when young and glabrous, dark gray when older; leaves are mostly three-lobed to less than half their length, and wedge to heart-shaped at base, green to yellow-green, warm yellow in fall; flowers are golden yellow, borne in a ascending calyx with spreading lobes and a narrow tubular hypanthium; Fruit is berries, round, glabrous, dark red to black and sometimes yellow and tart. Habitat includes river floodplains, streambanks, and moist ravines at mid elevations and on well-developed soils. This species can be propagated from seed or cuttings. Seeds are highly dormant and require 12 to 18 weeks of cold moist prechilling of freshly harvested seed, followed by a warm stratification and then continued prechilling to break dormancy. **Greenhouse asexual propagation** is by dormant, hardwood cuttings taken from late fall through early spring (one-two year wood), approximately of pencil diameter, wounded, with or without a heel, treated with 5,000 to 8,000 PPM IBA, a 1:1, vermiculite:perlite or sand media, under mist, under greenhouse conditions (35 to 65% rooting can be expected). Transplants should be placed in field at one to two years of age. **Field propagation** by dormant unrooted hardwood cuttings is somewhat successful. Rooting hormones are recommended to improve success rate.

CURRENT, WAX (SQUAW) - *Ribes cereum*:
A spreading to round shrub 1-2 m (3-7 ft) tall; stems are finely hairy, turning grayish to reddish-brown with age; leaves are kidney-wedge-fan shaped and shallowly 3-5 lobed with toothed edges, glabrous to downy with both surfaces somewhat glandular, dark green; flowers are both hairy and sticky, greenish-white to white, pink tinged with a nearly cylindrical hypanthium; fruit is berries, smooth, round, bright red and bitter. Habitat ranges widely from mid to high elevations on drier riparian slopes, foothills, to ponderosa pine forests, dry rocky southerly slopes and subalpine zones. Seeds usually mature in August. Depulp in a blender or macerator; cool, dry storage is recommended; cool, moist stratification (12 to 18 weeks) is required for freshly harvested seed prior to sowing. In some cases, a cold:warm:cold stratification series is needed to break dormancy; treatment with low concentrations of gibberellins for 1 to 8 days has been shown to produce germination rates of 30 to 55%; seed sown directly outdoors in December had only 1 percent germination by April in one study. **Greenhouse asexual propagation** by hardwood cuttings taken in June with a heel and treated with 8,000 ppm IBA, under mist. Transplants should be placed in field at one to two years of age. **Field propagation** by dormant unrooted hardwood cuttings as described for *Ribes aureum* should also work.

DOGWOOD, REDOSIER - *Cornus sericea*:
A thicket forming shrub, seldom with a single trunk to 5 m (16 ft) tall; bark is thin, smooth with prominent lenticels, red to occasionally greenish; branches rise, spread or bend downward to ground, smooth, slender and reddish to purplish red color; leaves are opposite, simple, deciduous, broadest near rounded base, tapering to a pointed tip, smooth along edge, dark green and smooth above, and covered with soft white hairs when young below becoming smooth when older, with unique 5-7 prominent upcurving and parallel veins that converge at tip of leaf; flowers in many four-lobed hairy calyx flat-topped clusters; fruit produced in round-topped clusters, round, dull white, thin flesh enclosing a egg-shaped, furrowed seed. Habitat is usually along streams, rivers, and other moist sites from low to relatively high elevations on soils that are commonly young with little to no development overlying gravel and cobbles. These sites are typically well to excessively drained with low waterholding capabilities that allow rapid movement of highly aerated

groundwater. It is most often grown by unrooted or rooted cuttings, but can also be grown from seed. Seed is collected in August and September; use a macerator to depulp, float off residue; store air dried seeds in sealed containers at 3 to 5°C (37 to 41°F) for two to four years; propagation requires cold stratification for 60 to 90 days at 5°C (41°F); seed coat scarification may improve germination; fall sowing is recommended; another recommendation is to prechill the seed for 28 days at 20 to 30° C, warm stratify for few days and rechill for 120-160 days prior to planting. **Greenhouse asexual propagation** by stem cuttings is easy and can be done either as actively growing soft or greenwood cuttings treated with 1,000 ppm IBA, under mist, or as dormant, hardwood cuttings treated with 3,000 to 5,000 ppm IBA, and placed under mist. Use a 1:1, perlite:vermiculite or high percent sand media. Actively growing cuttings should be at least 5 to 8 cm (2 to 3 in) in length and hardwood cuttings 8 to 16 cm (3 to 6 in). **Field propagation** by dormant unrooted hardwood cuttings is moderately successful. Dormant unrooted hardwood cuttings should be wounded through bark in multiple locations to enhance rooting and establishment. Plant in moist, well aerated soil. Redosier dogwood can also be propagated by layering. Layer existing stems by pulling branches to the ground and covering with soil, this will result in rooted material that can later be cut/dug and transplanted.

ELDERBERRY, BLUE - *Sambucus cerulea*:
A medium to large shrub with a broad crown and straight trunk from 2-4 m (6-13 ft) tall; bark is thick, irregularly ridged/furrowed, sometimes scaly, dark brown to reddish-brown; branches are stout, spreading, green and hairy when young becoming light brown and smooth with age, with triangular leaf scars and a thick white pith; leaves are opposite, deciduous, pinnate compound composed of 5-9 leaflets which are broadest at middle, rounded at base, pointed at tip and coarsely toothed along edge; flowers produced in broad, spreading, flat-topped yellowish-white clusters; fruit berries, dark blue to black and covered with a wax-like coating making berries appear pale blue, with 3-5 seeds per berry. Habitat is along banks, washes of streams, fence rows, rocky pastures and other drier riparian locations on well drained moist soils at mid elevations. Collect fruit in August and September, fresh fruit can be processed through a macerator and the pulp and empty seed floated off with water, or the fruit may be dried, rubbed down, and the seed applied directly in this form; processed seed can be stored for several years at 5°C; Recommendations for sexual propagation include storing dry seed at room temperature for 450 days, followed by cold stratification at 1°C (34°F) for 90 to 100 days prior to sowing, spring sowing recommendations include 3 days of presoaking, followed by stratification in vermiculite for 90 days at 5°C, sow to a depth of 0.6 cm (0.25 in) and cover with a thin layer of sawdust, use mulch on fall-sown seed; other recommendations include direct fall sowing soon after collection, or warm stratification for 10 weeks followed by prechilling for 12 weeks at 20 to 30°C and sown in spring. **Greenhouse asexual propagation** can be by either hardwood stem cuttings that include two-year-wood heel or softwood cuttings taken in June to July. The softwood cuttings are placed in vermiculite under mist with 60% shade for several weeks and will root approximately 30% of cuttings. Young seedlings can be transplanted at 1-2 years of age. **Field propagation** by dormant unrooted hardwood cuttings is somewhat successful. Cuttings taken from the previous season's growth during the winter are best. Always take with a heel to prevent exposure of the pith.

ELDERBERRY, RED - *Sambucus racemosa spp. pubens*:
A small to medium shrub 1-3 m (3-10 ft) tall very similar to blue elderberry except as noted; leaves are opposite, deciduous, pinnate compound composed of 5-7 leaflets which are broadest at middle, rounded at base, pointed at tip, sharply toothed along edge and hairy below; flowers produced in broad, spreading, rounded yellowish-white clusters; fruit berries, red to purple-black and with 3-5 seeds per berry. Habitat is along protected banks, washes of streams, fence rows, rocky pastures

and other drier riparian locations on well drained moist soils at low to mid elevations. Fruit ripens from June through September. Cleaning, handling, and storage of seed is the same as *Sambucus cerulea*; Pretreatment of seed includes H_2SO_4 scarification for 5 minutes followed by a two day water soak, then warm stratification for 10 weeks followed by cold chilling for 12 weeks at 20 to 30°C (68 to 86°F); fresh seed may be fall sown, or stratify stored seed as previously described before spring planting, germination typically occurs the second spring. **Greenhouse asexual propagation** is by softwood cuttings taken in June or July. A basal cut just below a node and removal of 30 to 40 percent of the foliage is recommended. Treat cuttings with Captan fungicide solution and approximately 3,000 to 5,000 ppm IBA. Place in vermiculite or a 1:1, peat:perlite mix, under mist with or without 60% shade for several weeks. Hot, humid greenhouse conditions are said to favor rooting, however, excessive moisture may cause the foliage to rot. Approximately 30% rooting can be expected. Young seedlings can be transplanted at 1-2 years of age. **Field propagation** by dormant unrooted hardwood cuttings is somewhat successful under conditions described for Blue elderberry. Note that cuttings do not do well in cold storage and should be planted early enough in the field to allow enough time to become established before winter. It can also be propagated by sprouts, rhizomes, and layering.

HAWTHORN, BLACK - *Crataegus douglasii*
HAWTHORN, DOUGLAS - *Crataegus douglasii var. douglasii*:
An erect shrub to small tree up to 10 m (33 ft) tall; branches are zigzagging stems, armed with stout 1 inch thorns and reddish brown in color aging to dirty gray; leaves are alternate, deciduous, obovate, irregularly toothed and can be 5-9 shallowly lobed, dark green to red when growing in full sunlight; flowers in axillary clusters, white; fruit is a small dark reddish purple to black globe-shaped apple in clusters. Habitat is generally in drier locations of riparian zones on clay loam to sandy loam soils at low to mid elevations. Watertable is generally within 40 in of the surface in spring or during high runoff events, but falls below this level later in the growing season. This species is tolerant of poorly drained soils and semi-prolonged flooding. Fruit ripens late-July through August, percent fill varies widely among trees necessitating frequent cutting tests, separate seed by macerating fruit and floating off pulp and empties, spread seed in thin layers to avoid heat build-up; Air dried seed can be stored for 2 to 3 years at 5°C (41°F); Propagation by seed requires pretreatment with acid for 0.5 to 3.0 hours followed by cold stratification at 5°C (41°F) for 84 to 112 days, germination of 50 to 80 percent is common, seed may be fall sown after pretreatment or held in cold storage after scarification until the following spring, sow seeds approximately 0.5 cm (0.2 inch) in depth or broadcast sow and cover to a similar depth with soil; transplant from seedbed before the second growing season, fresh seed may be fall sown directly without pretreatment, however, it may be two or more years before germination occurs. **Greenhouse asexual propagation** is possible by using suckers or by layering. . **Field propagation** by dormant unrooted hardwood cuttings is rarely successful.

SILVERBERRY - *Elaeagnus commutata*:
A multi-stemmed, deciduous shrub from 1.5 to 2.4 m (5 to 8 ft) tall, erect habit with slender and sometimes twisted branches, new stems are initially a light to medium brown color, the bark becoming dark gray, but remaining smooth, with age; the leaves are deciduous, alternate, 38 to 89 mm (1.5 to 3.5 inches) long and 19 to 38 mm (0.75 to 1.5 inches) wide; oval to narrowly ovate in shape, leaf margin entire, covered on both sides with silvery white scales, the bottom sometimes with brown spots; the highly fragrant, yellow flowers are perfect, trumpet-shaped (tubular), approximately 13 mm (0.5 inches) in length, borne in the leaf axils in May; the fruit is a silvery-colored, (0.3 inch) long, egg-shaped drupe that ripens in September-October, some fruit may persist on the plant until well into December; the seed is readily cleaned by processing in a

macerator, floating off the pulp, and then air drying; cleaned seed stored in sealed containers at 6 to 14 percent moisture content remains viable for up to 2 years. Propagation by seed is quite easy, fresh seed germinates readily with little (60 days or less) or no cold chilling. Late fall field sown seed germinates the next spring, spring sown seed usually germinates the same spring. **Greenhouse asexual propagation** with dormant hardwood cuttings treated with 3,000 ppm IBA, under mist with bottom heat, results in 80 percent, or better, rooting. This species spreads readily, sometimes profusely, by suckers. Information on the **Field propagation** of this species by dormant, unrooted hardwood cuttings is not available, but may prove successful on favorable sites. This native species is sometimes confused with the weedy, introduced small tree Russian olive, *Elaeagnus angustifolia*. Tolerates droughty, high pH and saline sites well.

SNOWBERRY, COMMON - *Symphoricarpos albus*:
A small, twiggy shrub from 30 to 150 cm (1 to 5 ft), the stems are erect, slender, and rounded with a hollow pith, the bark is brown, peeling and becoming stringy with age; the leaves are deciduous, opposite, simple, bluish-green in color, oval to elliptic-oblong, approximately 19 to 51 mm (0.75 to 2 inches) long, obtuse, roundish; the perfect, pinkish flowers are bell-like in shape, borne in terminal spikes on the current season's growth, usually in May to June; the fruit is a berry-like drupe, pure white, growing in dense clusters, approximately 15 mm (0.6 in) in diameter, ripening in September and October and sometimes persisting well into the winter months. Habitat - often found on alluvial terraces on major streams and rivers in mountain and foothill areas, but infrequently in dryer regions. Tolerates a wide variety of conditions including high pH, high clay, droughty, and medium shade sites. The seed is easily cleaned by maceration, floating off of the pulp, followed by air-drying of the seed. Propagation by seed requires a combination of 2 to 3 months warm stratification at about 21°C (70°F) followed by 4 to 5 months cold chilling at 5°C (41°F), 40 to 60 minutes of acid scarification prior to warm stratification may increase germination; germination is erratic and varies by year and even seed source; seed dried and then stored in sealed containers at 5°C (41°F) remains viable for up to 2 years; **Greenhouse asexual propagation** by softwood and dormant hardwood cuttings both root readily under greenhouse conditions that include 1,000 to 3,000 ppm IBA, bottom heat, and overhead mist. This species suckers profusely but is generally not weedy.

SYRINGA (MOCKORANGE) - *Philadelphus lewisii*:
A loosely branched medium to tall shrub 1-3 m (3 to 10 ft) tall; bark is brown with older stems showing a characteristic cross-checked pattern and eventually flaking off; leaves are opposite, deciduous, simple with a few to many rounded teeth on edges, light green, smooth to stiffly hairy with 3 major veins from base; flowers are numerous, very sweetly-scented, white, in terminal racemes on lateral branches; fruit is a nearly round capsule. Habitat is mostly in foothills and montane zone in ponderosa pine and Douglas fir forests, and in dry, rocky, moist streamside areas. Fruit is collected in late summer and is processed by gentle crushing of the dried capsules and then using wind from a clipper or similar machine to separate the seed from the chaff, cold stratify the seed for 8 weeks at 5°C (41°F) prior to sowing; **Greenhouse asexual propagation** is by softwood and hardwood stem cuttings, softwood cuttings are taken in June and July, treated with 1,000 ppm IBA, and stuck in a 1:1, peat:perlite media, under mist. Dormant hardwood cuttings are collected in late fall to early spring. They are treated with 2,500 to 8,000 ppm IBA, stuck in a sandy mix, under mist. Fall plantings should be mulched. Transplant at one to two years of age. . **Field propagation** by dormant unrooted hardwood cuttings is moderately successful. Moisture is the key to success.

ROSE, WOOD'S, *Rosa woodsii*:
An erect medium shrub from 1-2 m (3-7 ft) tall; stems are stout, strongly armed to unarmed (prickles); leaves are alternate, deciduous, odd-pinnately compound with 5-7 leaflets, coarsely toothed; flowers are small, pink, in terminal clusters on current years growth; fruit are red-hips from globose to elliptical or pear-shaped. Habitat, occurring as individuals or thickets on open slopes, roadsides and river and stream bottoms at low to mid elevations. Preferred soils vary from silt loam to sandy loam, are well drained and nonsaline. It is intolerant of poor drainage, high watertable and prolonged flooding. Fruit ripens from late summer through fall and is processed by maceration followed by the floating off of pulp and empty seed with water. Seed is stored dry in sealed containers at 1 to 3°C (34 to 37°F). Propagation by seed is either with fresh seed (without pretreatment) in the fall or pretreated seed in the spring. Pretreatment includes a warm stratification period of 60 to 90 days at 18 to 24°C (65 to 75°F) followed by prechilling for 90 to 120 days at 1 to 4°C (34 to 40°F). Cover seed with a shallow layer of soil approximately 0.5 to 2.0 cm (0.2 to 0.8 inch) in depth. Percent rooting of softwood and hardwood cuttings is low. . **Field propagation** by dormant unrooted hardwood cuttings is rarely successful. Root cuttings have bee successfully used to establish Wood's rose in moist environments.

SUMAC, SKUNKBUSH - *Rhus trilobata*:
A small to medium much branched dense shrub 1-3 m (3-10 ft) tall; stems are numerous, slender and much branched; leaves are alternate, green above and pale below, finely hairy when young, ill-scented when crushed, divided into 3 leaflets, middle leaflet is spatula-shaped with a wedge base and mostly three-lobed and coarsely toothed, the side leaflets are egg-shaped and mostly three-lobed and broadly toothed; flowers are in short dense clusters, yellow; fruit is a small globe-shaped berry, red, sticky hairy and numerous in short dense clusters. Habitat includes rocky hillsides, canyon bottoms, rocky riparian areas, stabilized blow sands and well-drained shorelines. These sites are typically excessively drained with low waterholding capabilities. Propagation can be performed with seed and by cuttings. Seed dormancy is caused by a hard seed coat and some embryo dormancy. It requires scarification with sandpaper, acid or warm water, and prechilling at 20 to 30°C for 30 to 60 days. . **Greenhouse asexual propagation** - The recommended propagation for hardwood cuttings is under greenhouse conditions. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful.

WILLOWS - *Salix spp.*:
Most willows can be propagated either from seed or dormant unrooted hardwood cuttings. Seed is very small which means a restricted food store that limits the viability of the embryo and dictates a short life span. Seeds have a viability range of one day to about two weeks. The seedbed must be fresh and fertile.

BEBB WILLOW - *S. bebbiana*:
Shrub-type; A shrub to small tree, 4-9 m (13-30 ft), with stems between 1-2 dm (4-8 in) thick. It has short brown slightly reddish branches that have long hairs that are wavy or curly, tangled, and either tightly or loosely appressed; leaves are narrow with a glaucous lower surface, entire margins (usually), and a distinctive shape. The shape is narrow at the bottom, wide about 2/3 up the leaf, and a point at the top; can be confused with Scouler's willow (see Scouler's Willow). Bebb's Willow is found from 1010-2410 m (3300-7900 ft) associated with the Douglas fir zone and non-subalpine mountain big sage habitat. Rarely is it the dominant willow. It is usually found with quaking aspen, water birch, and black cottonwood. In low elevations, it grows in moist to wet soils that are heavily organic to silty, sandy or gravelly. While in higher elevations, it is found on dry

riparian sites, but is rarely found on upland sites. **Field propagation** by dormant unrooted hardwood cuttings is moderately successful, although it does not have a high establishment rate.

BLACK WILLOW - *S. nigra*:
Tree-type; A tall tree to 30 m (100 ft) and round-topped; similar in many ways to Peachleaf willow; trunk is large, up to 1.8 m (6 ft) in diameter; older bark is deeply furrowed and dark brown; branches generally slender and outspreading; younger shoots yellowish and slightly pubescent; leaves long to 15 cm (6 in), narrow, and light green underneath; venation on the leaf somewhat pubescent; heart-shaped stipules; found along streams, marshes, swamps, lakes and ponds; native to the east and escaped or planted in the west. Generally found on the upper bank or floodplain; do not plant in the channel or bank-full width. **Field propagation** by dormant unrooted hardwood cuttings is very successful. Large diameter dormant unrooted hardwood cuttings can readily be taken and used for revegetation projects. Cuttings with deeply furrowed bark have a lower establishment rate than younger smooth barked hardwood cuttings. Deeply furrowed bark hardwood cuttings should be wounded before planting to stimulate rooting up and down the stem.

BOOTH WILLOW - *S. boothii*:
Shrub-type; Most common willow found in the west. Many-branched shrub with rounded top 2-3 m (6-10 ft) tall. Basal stems seldom larger than 5 cm (2 in). New to second year twigs are usually yellow and occasionally orange or brown. Leaves are the same color on both sides; very little hair on the back of older leaf; leaf is wider and not as long as Pacific willow. It found in mid-elevation areas; not found in hot canyon bottoms or cool highlands. It prefers coarse soils, but is found on deep fine-textured soils; usually associated with Geyer and Drummond willow. Replaced in lower elevations by *Yellow willow*. **Field propagation** by dormant unrooted hardwood cuttings is very successful. Cuttings can be planted at the bank-full width to the floodplain because the flexible branches can withstand high water velocities, ice, and debris loads.

COYOTE WILLOW - *S. exigua*:
Creeping-type; Commonly referred to as sandbar willow and dusky willow. This complex has been significantly condensed with new taxonomic methods. Generally, the complex is strongly suckering producing large thickets of slender stemmed willows. Basically, there are two subspecies are now recognized:

> *Salix exigua ssp. exigua*
> Shrub up to 8 m (26 ft) tall with narrow gray-green or silvery pubescent leaves that are entire with short petioles. Subspecies exigua is found below 1830 m (6000 ft) in the Wyoming big sagebrush zone on all soil textures. It prefers disturbed areas on stream edges and moist well-drained benches and bottomlands. Most often found with *Pacific and yellow willow, redosier dogwood, current species, black cottonwood,* and *water birch*.
>
> *Salix exigua ssp. melanopsis*
> Shrubs up to 4 m (13 ft) tall with narrow toothed leaves that are glaucous below. Typically found on stream edges. Range is above subspecies exigua and below 2130 m (7000 ft). Generally found in open riparian corridors within forested areas and in Mountain big sagebrush dominated valleys below the treeline. Prefers sandy to gravelly soils and bars in the channel. Most often found with *Drummond and Booth willow*.

One variety is recognized because of its floral similarities to *Salix exigua ssp. exigua* and vegetative similarities to *Salix exigua ssp. melanopsis*. This variety is *Salix exigua ssp. melanopsis*

var. tenerrima. It is a shrub up to 5-m (17 ft) with extremely narrow leaves that are green, glabrous, and nonglaucous.

Field propagation - Coyote willow is easily propagated from dormant unrooted hardwood cuttings. The largest diameter cutting possible will give the best establishment results. Cuttings can be planted below the bank-full width to reduce the velocity of the runoff water, thereby reducing the sediment load. Its flexible stems will bend down with the high water velocities, ice or debris flows, but they will return quickly to the upright position when the water has receded, or the ice melts or the debris moves off. One of the best willows for bioengineering and streambank stabilization projects.

DRUMMOND WILLOW - *S. drummondiana*:
Shrub-type; A shrub that grows 2-4 m (6-14 ft) tall; new stems have a glaucous (white waxy) covering with a red color (sometimes purple to green) underneath; leaves narrow at the base, widening out at the upper middle, and rounding off at the top; leaves are dark on top with a silver-velvety pubescence underneath that appears to be glaucous, but won't rub off; Common from lower edge of the forest zone up to the middle of the subalpine zone; more abundant in the higher elevation stream corridor areas dominated by Englemann spruce or subalpine fir; it grows on moist, well-aerated soils; associated with *current, honeysuckle*, and *groundsel species*. **Field propagation** by dormant unrooted hardwood cuttings is very successful. Small to medium shrub with flexible stems that can be planted from low to mid-slope to floodplain. Multiple stems will intercept streamflow and slow velocities down and then return to upright position after the water, ice, or debris has gone down.

GEYER WILLOW - *S. geyeriana*:
Shrub-type; A shrub up to 6 m (20 ft) tall; stems are numerous, straight, and slender; new stems are green with a heavy white glaucous coating (heaviest coating on new growth from the basal cluster); leaves dark and hairy above with hair and white powder on the underside that will rub off with the thumb; commonly found between 1220-2440 m (4000 - 8000 ft); absent from low elevation riparian zones and subalpine zones; concentrated in the upper part of the Wyoming big sage zone to the upper Douglas fir zone; typically found in the drier parts of the riparian zone (benches back from the stream) and side branches of the stream system; likes deep, fine-textured soils with a overstory of thinleaf alder, water birch, and lodgepole pine; often considered to grow as tall as the soil is deep; will grow on clayey soils better than *Drummond willow*; associated with *Booth willow* which will grow in the wetter areas of the riparian corridor while Geyer's grows in the drier areas; very close taxonomically to *Lemmon willow and they* may be synonymous. **Field propagation** by dormant unrooted hardwood cuttings is highly successful.

LEMMON WILLOW - *S. lemmonii*:
Shrub-type; Small to medium shrub about 1-3 m (3-10 ft); stems are dark (almost black), crooked, and numerous; new stems are heavily glaucous, especially those arising from the base; leaves green without hairs above and white below (thinly hairy and glabrous); commonly found at higher elevations than Geyer willow on dryer portions of the riparian zone, upper part of the Douglas fir zone to the lower subalpine zone; soils are generally well-drained gravelly or sandy soils; closely associated with *Drummond and Booth willow*, and *birch species* which will generally be found on wetter areas; Multiple stemmed willow is easily propagated from dormant unrooted hardwood cuttings; *Lemmon willow* should be planted at upper middle elevations on somewhat drier areas adjacent to the stream; very close taxonomically to *Geyer willow and they* may be synonymous. **Field propagation** by dormant unrooted hardwood cuttings is very successful.

MACKENZIE WILLOW - *S. prolixa (S. mackenzieana, S. rigida var. mackenzieana)*:
Tree-type; Small tree from 6-9 m (20-30 ft) tall; Thick-branched, with several thick limbs coming from a very short base; wide crown; stems long, slender, and flexible with new stems glabrous and glossy; leaves of medium length (5-7 times longer than wide), fine-toothed, and short pointed tip, top is yellow-green while bottom is whitish with no hair underneath, no glands at base of leaf; new stems reddish brown to yellowish, no hair; habitat and soils are similar to *Pacific willow*. Large tree that should not be planted within the bankfull width. Plant at top of channel and on floodplain. **Field propagation** by dormant unrooted hardwood cuttings is moderately successful.

PACIFIC (WHIPLASH) WILLOW - *S. lucida spp. lasiandra (S. lasiandra)*:
Tree-type; A tree up to 16 m (53 ft) tall with several branches that have stems between 10-30 cm (4-12 in) in diameter. Bark ranges from moderately deep furrows on the older part of the stem to smooth whitish bark on the younger part of the branch. The leaf is long, usually has a slight bend at the top, and a very pointed tip. The leaf has the same color on both sides and 1-3 small dark glands where the leaf meets the petiole. It is found in low to mid elevations, generally below 2000 m (6500 ft). At lower elevations, its form is a mid-sized tree, while at mid-elevation areas is has a smaller shrubby stature. It prefers moist sandy to gravelly well-drained soils similar to those preferred by cottonwoods. It is commonly associated with Drummond, Booth and *yellow willow, redosier dogwood*, Woods rose, and *alder species.* **Field propagation** by dormant unrooted hardwood cuttings is very successful. For better rooting success, use younger smooth barked stems. If using the older, larger diameter stems with rough furrowed bark, scar the rough bark with an axe down to the cambium layer and use rooting hormones. This willow should not be planted in the stream channel (within the bankfull width), but rather at the top of the bank and on the floodplain.

PEACHLEAF WILLOW - *S. amygdaloides*:
Tree-type; small to tall tree with different references reporting height from 9-27 m (30-90 ft) tall and single base from .3-1.2 m (1-4 ft) in diameter. It usually has 1-3 leaning trunks off the main trunk. Leaves are long (6-7 times as long as wide), with a long point at the top. They are yellow-green on the top and whitish underneath, hairless and fine-toothed, and without glands. The stems are shiny, hairless, orange-yellow to red-brown, and drooping. The bark is dark with deep furrows and sharp ridges at the base going up to smooth lighter bark on middle aged branches. Its habitat is mainly mid-elevation. Prefers fertile soils near water or on alluvial soils with moving subsurface water. **Field propagation** by dormant unrooted hardwood cuttings is rarely successful. High establishment success has been found with younger-aged wood. This willow is ideal for planting into rock riprap on upper bank. It should not be planted within the bankfull width, but at the top of bank and on the floodplain.

PLAINLEAF WILLOW - *S. planifolia var. planifolia*:
Shrub-type; Medium shrub from 2-4 m (6-13 ft) tall. New stems are glabrous and older stems are dark red or brown and glabrous to waxy. Leaves are glabrous, dark green (occasionally red-tinged) and shiny above, glabrous beneath, not toothed. It is called the "parallel-veined willow" because the lateral veins in the leaves are partially parallel to the main vein. Found at mid-elevation 1680-2350 m (5500-7700 ft) in moist streamside and bottomlands of the mountain big sagebrush/grass zone. Preferred soils are varied from deep silts, clay, sand, or gravel. Associated with *Bebb, Booth, Geyer, yellow, and coyote willows.* **Field propagation** by dormant unrooted hardwood cuttings is moderately successful.

SCOULER WILLOW - *S. scouleriana*:
Upland Shrub-type; Large shrub to tree commonly 6-10 m (20-33 ft) and up to 15m (50 ft) tall. It is highly variable. New stems have "peach-fuzz" while older stems can be glabrous or with some "peach-fuzz." New stems are yellow to dark with a tendency to droop. Older stems have a skunky odor when bark is stripped. Leaves are 2-4 times longer than wide, generally glabrous and green above, and bottom with red-tinged (distinctive) "peach-fuzz" and later waxy. Margin is wavy-edged; top is blunt or short-tipped, widest near tip. Found at mid to high elevation, 1000-2400 m (3300-8000 ft). Likes some moist areas, but generally drier upland sites especially in higher elevations. Associated with *quaking aspen*, *black cottonwood*, *thinleaf alder*, *Bebb*, *yellow*, *coyote*, *Pacific*, *Booth*, and *Geyer willows*. This willow is not usually planted in riparian channels. **Field propagation** by dormant unrooted hardwood cuttings is usually difficult.

SITKA WILLOW - *S. sitchensis*:
Shrub-type; Small tree or shrub 1-8 m (3-25 ft) tall. Branches are dark brown to gray and sparsely hairy. Twigs are densely velvety and brittle at the base. The leaves are alternate, deciduous, broad and tapering from above the middle to the base. They are 4-9 cm (2-3.5 in) long with the upper side bright green and sparsely silky and the lower side is satiny with short hairs pressed flat. The margins are smooth or with tiny glandular teeth. The leaf stalks are yellowish, velvety and 5-15 cm (2-6 in) long. Stipules are half-oval and they fall off early in the season on slow growing twigs or they are retained throughout the season. Sitka willow is common along streams and rivers in thickets, lakeshores and wetland margins, forest edges and wet openings, and clearings. It can be found in low to mid elevations. **Field propagation** by dormant unrooted hardwood cuttings is fairly easy.

WHITE WILLOW - *S. alba*:
Tree-type; medium to large tree, 12-22 m (40-65 ft) tall, with low hanging branches that form a broad spreading round crown. Twigs are nearly hairless to silky. Leaves are 5-15 cm (2-6 in) long and 1-3.5 cm (.35-1.25 in) wide, long-pointed, v-based, and fine toothed. Leaves are gray-green above and whitened with silky-haired beneath. Glands are present at the leaf bases and stipules are lacking. White willow is prone to insect attacks. The most common white willow on the market is a selection called the golden willow. Plant out of the bankfull width on the upper channel areas and floodplain. It can be found at low to mid elevations. **Field propagation** success by dormant unrooted hardwood cuttings is moderate to good.

YELLOW WILLOW - *S. lutea*:
Shrub-type; Rounded shrub 3-6 m (1-3 ft), sometimes to 8 m (3 ft) tall. It will occasionally become a multistemed tree with stems up to 20 cm (8 in) thick. Twigs are glabrous and generally yellowish-white to gray to robin-egg blue. Leaf is green above and pale, glaucous below. Leaf margins are fine toothed to inconspicuously toothed to entire. Stipules are small and inconspicuous or larger on vigorous shoots that are eventually deciduous. Yellow willow is commonly found at elevations between 610-1372 m (2000-4500 ft). It is rarely found as a single species. Often found with coyote willow or pacific willow. It grows on a wide variety of soils from coarse cobble along streams to moist terraces with deep, fine textured soils. **Field propagation** by dormant unrooted hardwood cuttings is very successful.

NOTE: *MANY OF THESE SPECIES ARE COMMERCIALLY AVAILABLE AS POTTED OR BARE ROOT STOCK AND MAY BE PURCHASED FOR TRANSPLANT.*

Appendix A, B
Woody Plant Characteristics

Narrowleaf Cottonwood
Populus angustifolia

(Drawing by G. Bentrup)

Appendix A -Description of Native Shrubs and Trees For Riparian Areas in the Intermountain West (after Bentrup and Hoag, 1998)

Species	Size/Form	Elevation Range[1]	Root Type	Rooting Ability from cuttings	Availability In Field[2]	Use in Riparian Zone[3]
Acer negundo Boxelder	Med. Tree	Low - Mid.	Moderately Spreading	Poor	Common	4
Alnus rubra Red alder	Med. Tree	Mid. - High	Shallow Spreading	Poor	Fairly Common	3,4
Alnus sinuata Sitka alder	Sm.-Med. Tree	Mid. - High	Shallow Spreading	Poor	Fairly Common	2,3
Alnus incana spp. tenuifolia Thinleaf alder	Sm.-Med. Tree	Mid. - High	Shallow Spreading	Poor	Common	2,3
Betula occidentalis Water birch	Lg. Shrub to Sm. Tree	Mid. - High	Shallow to Deep Spreading	Poor	Fairly Common	2,3
Cornus sericea Redosier dogwood	Med. Shrub	Mid.	Shallow	*Moderate	Fairly Common	2,3,4
Crataegus douglasii Black/Douglas hawthorn	Sm. Tree	Low - Mid.	Shallow to Deep Spreading	Poor	Fairly Common	3,4
Elaeagnus commutata Silverberry	Med. Shrub	Low - Mid.	Shallow to Deep Spreading	V. Good	Very Common	3,4
Pentaphylloides floribunda Shrubby cinquefoil	Sm. Shrub	Low - Mid.	Shallow to Deep Spreading	Poor	Very Common	3,4
Philadelphus lewisii Mockorange	Sm. - Med. Shrub	Low-Mid.	Spreading Fibrous	Poor	Common	3,4
Populus angustifolia Narrowleaf cottonwood	Lg. Tree	Mid.	Shallow	Very Good	Very Common	4
Populus fremontii Fremont cottonwood	Lg. Tree	Low - Mid.	Shallow Fibrous	Very Good	Fairly Common	4
Populus tremuloides Quaking aspen	Med. Tree	Mid. - High	Shallow	Poor	Very Common	4
Populus trichocarpa Black cottonwood	Lg. Tree	Low - Mid.	Shallow Fibrous	Very Good	Very Common	4
Prunus virginiana Chokecherry	Med. - Lg. Shrub	Low - Mid.	Rhizomatous	Good from root cuttings	Common	4
Rhus trilobata Skunkbush sumac	Med. - Lg. Shrub	Low - Mid.	Deep Spreading Rhizomatous	Poor	Fairly Common	4
Ribes aureum Golden current	Sm. - Med. Shrub	Low - Mid.	Spreading	Good (in greenhouse)	Common	3
Ribes cereum Wax/Squaw current	Sm. - Med. Shrub	Mid. - High	Spreading	Fair	Common	3,4
Rosa woodsii Wood's rose	Sm. - Med. Shrub	Low - Mid.	Shallow to Deep	Good (in greenhouse)	Very Common	2,3,4
Sambucus coerulea Blue elderberry	Sm. Tree	Mid.	Rhizomatous	Poor	Fairly Common	4
Sambucus racemosa Red elderberry	Med. Shrub	Mid. - High	Spreading	Poor	Fairly Common	4
Shepherdia argentea Silver buffaloberry	Lg. Shrub	Low - Mid.	Rhizomatous	Poor	Fairly Common	4
Symphoricarpos albus Common Snowberry	Sm. Shrub	Low - Mid.	Spreading	V. Good	Very Common	3,4

Footnotes:

U = Unknown

1. Elevation Range
   Low 2000-4500
   Middle 4500-7000
   High 7000-10000

2. Availability in the field
   -refers to natural occurrences in the region. Ranking is from least to greatest.

3. Riparian Zones
   1- Toe zone
   2- Bank zone
   3- Overbank zone
   4- Transitional zone
   5- Upland zone

4. Commercial Availability:
   Refers to availability of species in the nursery trade.

5. Deposition Tolerance:
   Regrowth following shallow coverage by soil.

Commercial Availability[4]	Deposition Tolerance[5]	Flooding Tolerance[6]	Drought Tolerance[7]	Salinity Tolerance[8]	Wildlife Value/Misc. Notes	Plant Ind. Status[9]
Yes	High	High	High	Med.		FAC
Yes	Med.	Med.	Low	Low	Big game browse upland bird food	FAC
Yes	Med.	Med.	Low	Low	Big game browse upland bird food	FACW
Yes	Med.	Med.	Low	Low	Big game browse upland bird food	FACW
Yes	Med.	Med.	Low	Low	Big game browse	FACW
Yes	Low	High	Med.	Low	Big game browse, small mammal food food, upland bird food.	FACW
Yes	Med.	Low	High	Low	Browse for many species and cover	FAC,U
Yes	High	High	Med.	Med.	Big game browse	FAC
Yes	U	U	High	U	Big game browse	FACW FAC
Yes	U	U	U	U	Big game browse	FACU,U
Yes	Med.	Med.	High	Med.	Big game browse	FACW
Yes	Med.	Med.	Med.	Med.	Big game browse	FACW
Yes	Low	Low	Med.	Med.	Big game browse	FAC FACU
Yes	Med.	Med.	Med.	U	Big game browse	FACW
Yes	Low	Low	Low-Med.	Low-Med.	Birds and small mammals eat fruits	FACU
Yes	High	Med.-High	Med.-High	Med.	Birds and small mammals eat fruits Can not tolerate long-term flooding	FACU,U
Yes	U	U	U	U	Birds and small mammals eat fruits	FAC FACW
Yes	U	U	U	U	Birds and small mammals eat fruits	FACU,U
Yes	U	Low	Low-High	Low	Rosehips eaten by many species	FACU
Yes	Med.	Med.	Med.	Low	Fruits are important for birds	FAC
Yes	Med.	Med.	Med.	Low	Big game browse Fruits eaten by birds and small mammals	FACU FACU
Yes	U	U	U	Low	Fruits eaten by birds and small mammals	FACU
Yes	Med.	Med.	Med.	Low	Fruits eaten by birds and small mammals	FACU

6. Flooding Tolerance:
   High- tolerates 10-30+ days
   Medium- tolerates 6-10 days
   Low- tolerates 1-5 days or less
7. Drought Tolerance:
   Resistance to drought relative to native sites.
8. Salinity Tolerance:
   Resistance to salinity relative to native vegetation on similar sites.
9. Plant Indicator Status:
   OBL- Obligate
   FACW- Facultative Wet
   FAC- Facultative
   FACU- Facultative Upland
   Upland- Upland

Appendix B -Description of Native Shrubs and Trees For Riparian Areas of the Intermountain West (after Bentrup and Hoag, 1998)

Species	Size/Form	Elevation Range[1]	Root Type	Rooting Ability from cuttings	Availability In Field[2]	Use in Riparian Zone[3]
Salix alba White/Golden willow	Med. - Lg. Tree	Low - Mid.	Shallow to Deep	Good	Common	4
Salix amygdaloides Peachleaf willow	Sm. Tree	Low	Fibrous	Very Good	Common	4
Salix bebbiana Bebb's willow	Lg. Shrub	Low to Mid.	Shallow to Deep	Good	Common	4
Salix boothii Booth willow	Med. Shrub	Mid.	Shallow to Deep	Moderate	Very Common	2,3
Salix drummondiana Drummond willow	Sm. - Med. Shrub	Mid. - High	Shallow to Deep	Good	Common	2,3
Salix exigua Coyote willow	Med. Shrub	Low - Mid.	Rhizomatous	Very Good	Very Common	2,3,4
Salix geyeriana Geyer willow	Med.. Shrub	Mid.	Shallow to Deep	Good	Very Common	2,3
Salix lasiandra Pacific willow	Sm. Tree	Low - Mid.	Shallow to Deep	Good	Common	4
Salix lemmonii Lemmon willow	Sm. - Med. Shrub	Mid. - High	Shallow to Deep	Good	Fairly Common	2,3
Salix lutea Yellow willow	Med. - Lg. Shrub	Low	Shallow to Deep	Good	Very Common	2,3
Salix nigra Black Willow	Lg. Tree	Low - Med.	Shallow to Deep	Good	Fairly Common	4
Salix planifolia Planeleaf willow	Sm. Shrub	Mid. - High	Shallow to Deep	Moderate	Fairly Common	2,3
Salix prolixa Mackenzie willow	Sm. Tree	Low - Med.	Shallow to Deep	Good	Fairly Common	3
Salix scouleriana Scouler willow	Lg. Shrub	Low - Mid.	Shallow to Deep	Need to treat with hormone	Fairly Common	5 (upland willow)
Salix sitchensis Sitka willow	Sm. - Med. Tree	Low - Med.	Shallow to Deep	Moderate	Common	3

Footnotes:

U = Unknown

1. Elevation Range
   Low 2000-4500
   Middle 4500-7000
   High 7000-10000

2. Availability in the field
   -refers to natural occurences in the region.
   Ranking is from least to greatest.

3. Riparian Zones
   1- Toe zone
   2- Bank zone
   3- Overbank zone
   4- Transitional zone
   5- Upland zone
   6- Unknown

4. Commercial Availability:
   Refers to availability of species in the nursery trade.

5. Deposition Tolerance:
   Regrowth following shallow coverage by soil.

Commerical Availability[4]	Deposition Tolerance[5]	Flooding Tolerance[6]	Drought Tolerance[7]	Salinity Tolerance[8]	Wildlife Value Misc. Notes	Plant Ind. Status[9]
Yes	High	High	Med.	Low-Med	Willows are good browse and provide excellent cover for many species.	FACW
Yes-limited	High	High	Low	Med.	Willows are good browse and provide excellent cover for many species.	FACW
Yes-limited	High	High	Low - Med.	Low	Willows are good browse and provide excellent cover for many species.	FACW
Yes-limited	High	Med. - High	Low - Med	Low	Willows are good browse and provide excellent cover for many species.	FACW
Yes-limited	High	Med. - High	Low - Med	Low	Willows are good browse and provide excellent cover for many species.	FACW
Yes	High	Med. - High	Low - Med.	Low	Willows are good browse and provide excellent cover for many species.	OBL
Yes-limited	High	Med. - High	Low - Med	Low	Willows are good browse and provide excellent cover for many species.	OBL
Yes	High	Med. - High	Low - Med	Low	Willows are good browse and provide excellent cover for many species.	FACW
No	High	Med. - High	Low - Med	Low	Willows are good browse and provide excellent cover for many species.	FACW
Yes-limited	Med.	Med. - High	Low - Med.	Med.	Willows are good browse and provide excellent cover for many species.	FACW OBL
Yes	Med.	Med. - High	Low - Med.	Low-Med	Willows are good browse and provide excellent cover for many species.	FACW OBL
No	High	Med. - High	Low - Med.	Low	Willows are good browse and provide excellent cover for many species.	OBL
Yes-Limited	High	Med. - High	Low - Med.	Low	Willows are good browse and provide excellent cover for many species.	OBL
Yes	High	Med. - High	Low - Med.	High	Willows are good browse and provide excellent cover for many species.	FACU FAC
Yes-Limited	High	Med. - High	Low - Med.	Low	Willows are good browse and provide excellent cover for many species.	FACW

8. Salinity Tolerance:
   Resistance to salinity relative to native vegetation on similar sites.

9. Plant Indicator Statis:
   Based on occurance in wetland
   - OBL- Obligate
   - FACW- Facultative Wet
   - FAC- Facultative
   - FACU- Faculatative Upland
   - Upland- Upland

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