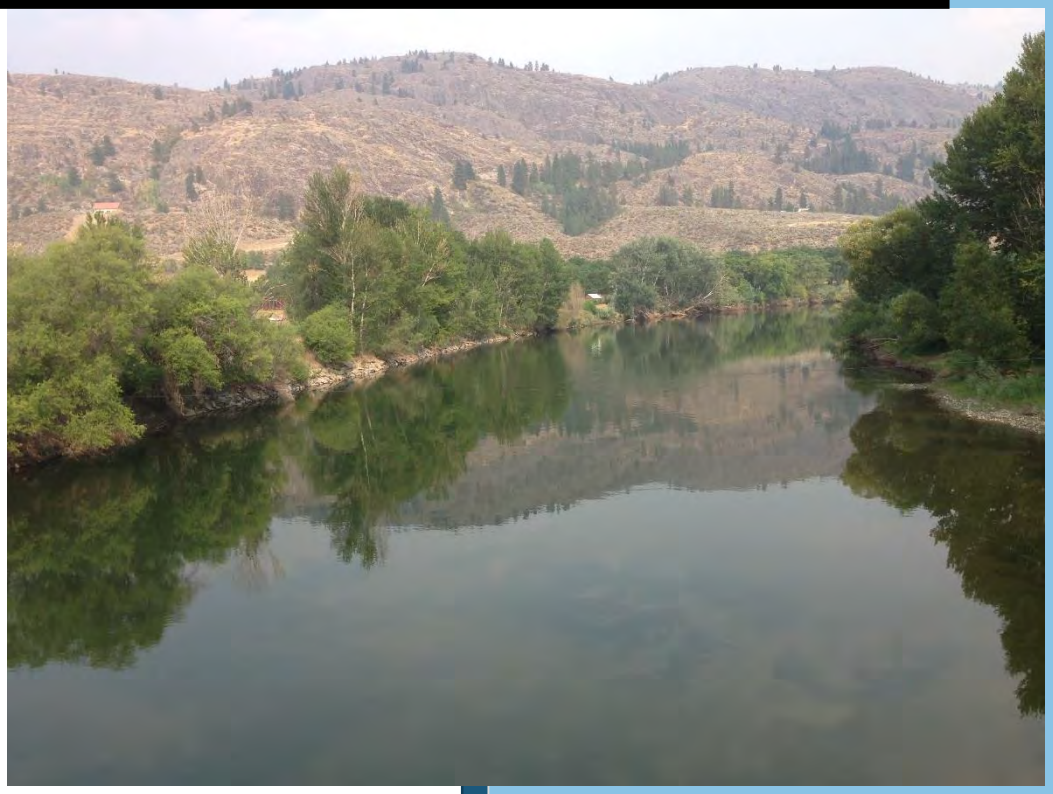
**Appendix A**

Town of Riverside

# Shoreline Inventory and Characterization



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# 1 INTRODUCTION

## 1.1 Purpose

In 2014, the Town of Riverside obtained a grant from the Washington Department of Ecology (DOE) to conduct a characterization of its shoreline jurisdiction as defined by the state's Shoreline Management Act (RCW 90.58). The characterization is the description of the ecosystem wide and shoreline processes, shoreline functions, and opportunities for restoration, public access and shoreline use. It will provide the basis for the Town's Shoreline Master Program (SMP) update by helping the Town to identify existing shoreline conditions, determine the functions and values of shoreline resources, and explore opportunities for conservation and restoration of ecological functions within the jurisdiction area. This will make it possible to identify solutions to shoreline issues and to develop shoreline designations, policies, and development standards to protect the Town's shoreline. Riverside does not currently have a shoreline plan, so this inventory and characterization report will contribute to the first such plan prepared for the community.

## 1.2 Shoreline Jurisdictional Area

The Shoreline Management Act (SMA) applies to more than 20,000 miles of shorelines in the state. This includes 2,300 miles of lake shores, 16,000 miles of streams, and 2,400 miles of marine shorelines. Shorelines are defined in the SMA as: all marine waters, segments of streams where the mean annual flow is more than 20 cubic feet per second, lakes and reservoirs 20 acres and greater in area, associated wetlands, and shorelands adjacent to these water bodies. This is typically the land area within 200 feet of the Ordinary High Water Mark (OHWM) from the water body. The OHWM is not a fixed elevation and can move as the shoreline changes over time. It is determined by visual inspection of the river, lake, wetland, or marine bank. A complete definition for the OHWM is provided in the SMA [RCW 90.58.030(2)(a)].

The Okanogan River, which flows through the Town of Riverside, is designated as "shoreline of statewide significance". East of the Cascades, the SMA defines a shoreline of statewide significance as: "natural rivers or segments thereof" that has a mean annual flow of 200 cubic feet per second or more, or those portions of rivers east of the crest of the Cascade range downstream from the first three hundred square miles of drainage area, whichever is longer. This definition applies to the entire length of the Okanogan River in Washington State. The river is the only water body located within Riverside that is designated as a shoreline of the state. Shorelines of the state are defined by the SMA as the total of all "shorelines" and "shorelines of statewide significance" within the state.

A goal of the comprehensive local SMP updates is to ensure that all water bodies subject to the SMA shoreline jurisdiction are covered by local SMPs. It is the responsibility of local governments to identify jurisdiction for the shorelands along their stream corridors within minimum and maximum areas as defined in the SMA [RCW 90.58.030(20)(d)]. The shoreline jurisdiction area in the Town of Riverside will include the Okanogan River and all lands that are located within 200 feet of the floodway edge or OHWM, whichever is further landward, and any associated wetlands. For streams, an entire wetland is associated if any part is located within the 100-year floodplain of a shoreline or within 200 feet of the OHWM or floodway.

### 1.3 Report Organization and Methodology

Guidance provided in Chapter 7 – Shoreline Inventory and Characterization from the Department of Ecology's SMP Handbook was consulted to formulate the methodology used in this analysis. This inventory and characterization report draws upon existing regional reports, studies, and Geographic Information System (GIS) data to determine existing and emerging problems and issues in the town's shoreline jurisdiction. The report provides findings through narrative and associated maps to help inform SMP planning decisions. It will be the basis for assigning environmental designations, developing policies, regulations, preparing a restoration plan, and conducting a cumulative impact analysis.

The report begins by looking at the ecosystem wide conditions of the Okanogan Watershed, of which Riverside's shoreline is just a small part. The purpose of this broad look at the entire watershed is to get a better understanding of certain ecosystem-wide processes that may affect the town's shoreline, and also to determine what impacts various land uses have had on the watershed as a whole. It is important to recognize that the town's shoreline can't be properly managed in isolation from areas upstream and outside of the jurisdiction. Processes and land uses occurring both within and outside of Riverside have a direct impact on the town's shorelines. Section 2 of the report provides the Ecosystem-wide summary. A brief summary of many characteristics of the watershed are discussed, including its physical location and size, geology and topography, climate and hydrology, vegetation cover, native and introduced fish and wildlife, cultural factors including historic and modern uses and modifications, land ownership, uses, and cover, and water quality issues. The section finishes by evaluating potential restoration opportunities for Riverside's shoreline based upon issues learned during the ecosystem-wide summary.

Following the ecosystem-wide summary section of the report, the town's shoreline becomes the primary focus. In Section 3 – Reach Inventory and Analysis, the town's shoreline is split into reaches in order to better characterize ecological functions and to determine how those functions may be impacted or impaired by existing shoreline modifications and uses. Reaches are typically distinguished by the relative intensity of land use development patterns, physical landscape, and/or critical biological processes. GIS data is utilized to prepare maps that enable reaches to be delineated along Riverside's shoreline by showing these distinctive features.

## 2 ECOSYSTEM-WIDE SUMMARY

### 2.1 Location

The Okanogan Watershed is a sub-watershed of the Columbia River Watershed located in north central Washington State. The Okanogan River originates in British Columbia and flows through four lakes (Okanagan, Skaha, Vaseaux, and Osoyoos), before entering into the State of Washington. The Okanogan Watershed encompasses a total area of about 8,400 square miles, of which approximately 2,100 square miles lie within Washington (Reference #1). The Okanogan River runs primarily north to south, and has a total length of about 79 miles within Washington as measured from Lake Osoyoos to its confluence with the Columbia River near Brewster (Reference #2). The Town of Riverside is located along the central portion of the river, about 39 miles north of Brewster. Most of the city is located on the west side of the river, with only a small portion lying on the east banks.

Most all of the streamflow in the Okanogan River in Washington is contributed by the Okanagan and Similkameen rivers flowing out of British Columbia (Reference #1). The Similkameen River is the largest

tributary of the Okanogan River, and originates on the west slopes of Nicomen Ridge in the Cascade Mountains of southern British Columbia. The Okanagan River, as it is known in Canada, also originates in southern British Columbia, issuing out of the southern end of Okanagan Lake. Major tributaries to the Okanogan River in Washington include Johnson, Salmon, Loup, and Chiliwist Creeks draining into the river from the west, and Tonasket, Antoine, Siwash, Bonaparte, Tunk, Omak, and Nine Mile Creeks draining from the east (Reference #2). Johnson Creek enters the Okanogan River within the Town of Riverside city limits. It is about 7.9 miles along. The reach of the creek flowing in Riverside between Highway 97 and the confluence with the Okanogan River is intermittent and occasionally flows subsurface (Reference #3). Johnson Creek originates on the east slope of the Cascade Mountains, to the west of Riverside.

Figure 1: Regional Context, shows the location of the Okanogan River watershed in Washington, as well as land ownership, developed areas (cities), and roads.

### 2.2 Geology and Topography

The Okanogan River is considered to be the northernmost divide between the Cascade Mountains to the west and the Rocky Mountains to the east. The river runs through a mountainous region, and is bounded to the east and west by steep, rugged ridgelines and peaks ranging in elevation from 1,500 feet to more than 6,000 feet as measured from the river valley floor. The main stem of the river in Washington State only varies in elevation from about 920 feet at the international border to about 780 feet at its confluence with the Columbia River, making for a very flat gradient stream. The gradient on the US portion of the main stem Okanogan averages about 0.04 percent (Reference #4). The floodplain of the Okanogan River valley is fairly narrow, measuring only about one mile wide on average (Reference #2). Steep slopes located on both sides of the river limit the extent of the flood plain at most locations.

The Town of Riverside is located in the central portion of the Okanogan River Valley in Washington State. Most of the town is located on the valley floor where topography is fairly flat. Elevations adjacent to the river within city limits range from about 850 feet on the north side of town to about 848 feet on the south side. Higher elevation and steeper areas within city limits occur on undeveloped parcels located to the west. Rock outcrops and upland areas near the southwest corner of town reach a maximum elevation of about 1,420 feet.

During the late Pleistocene epoch, which ended approximately 11,700 years ago during the world's most recent period of repeated glaciations, the Okanogan Lobe of the Cordilleran ice sheet covered much of the Okanogan Basin below 5000 feet. The erosive action at the base of the ice sheet deposited till consisting of unconsolidated and unsorted mixtures of silt, sand, gravel, and stone at depths greater than 500 feet thick in some areas (Reference #1). Glacial fluvial meltwater streams deposited large quantities of well sorted sands and gravels on the margins of the ice sheet at the lower elevations of the basin. Glacial meltwater also created lacustrine deposits of clay soils in areas of low gradient or localized impoundment that allowed these fine sediments to settle out of the water column. Deposits of volcanic ash from eruptions in the Cascade Mountains during the Pleistocene and Holocene also occur in the basin (Reference #2). The ash deposits are from two major volcanic eruptions: the Glacier Peak eruption in the North Cascades about 12,000 years ago, and the Mount Mazama (Crater Lake) eruption in the southern Oregon Cascades about 6,600 years ago (Reference #5).

Most of the basin's bedrock is made up of highly fractured, folded, and faulted rocks. The bedrock geology presents a confused array of rock types, formations, and development sequences including basaltic lava flows, carbonaceous sedimentary beds, intrusive granites, and strongly foliated gneisses. Episodes of mountain building and erosion have modified the original geological structures.

### 2.3 Soils

Soils in the Okanogan Basin are highly variable as a result of the mountainous terrain, differing parent materials, and resulting microclimate differences. Soils formed from a wide variety of parent material, including residuum and colluvium derived from granitic, metamorphic, sedimentary, metasedimentary, and volcanic rock. Other soil types originated from glacial deposits of till, outwash, glaciofluvial sediment, and glaciolacustrine sediment, volcanic ash and pumice, loess, alluvium, and decomposing plant material. Generally, the soils on ridges, shoulders, and upper back slopes in the area tend to be shallower to bedrock than those located on lower back slopes and foot slopes. Soils in steep mountainous areas are generally shallower due to erosion and colluvial action, such as soil creep and landslides (Reference #5).

In the Okanogan Valley in the vicinity of Riverside, most soils are formed in materials derived from glaciation from the last 10,000 years, or from alluvium layers deposited more recently by streams in the area. Examples of glacial deposited soils in the area include Cashmere, Pogue, and Tonasket soils. Cashmere soils formed in coarse-loamy and sandy material transported and deposited from glacial meltwater. Pogue soils were formed in sandy-skeletal glacial outwash. Tonasket soils consist of stratified silt, clay, and sand that settled out of small glacial lakes created when glaciers dammed small side drainages. All of these soils are deep and range from well drained to somewhat excessively drained. Colville soil is a type of alluvium soil found in the Okanogan River flood plain in Riverside. It is comprised of silt loams that are classified as poorly drained. On the upland areas surrounding Riverside, other types of soils are present including Lithic Haploxerepts – Cashmont complex, and rock outcrop. The parent material of Lithic Hoploxerepts – Cashmont complex is comprised of volcanic ash or mixed volcanic ash over colluvium and residuum. This well drained soil consists of cobbly ashy sandy loam and very gravelly sandy loam over unweathered bedrock (Reference #5).

Figure 9: Soil Type provides a breakdown of the soil types present within Riverside's city limits.

### 2.4 Climate and Hydrology

The climate of the Okanogan River basin is strongly influenced by the rain shadow effect created by the Cascade Mountains to the west. As moist Pacific air masses are forced up and over the Cascades from the west, the air is cooled and most moisture falls as rain or snow on the windward (west) side of the mountains. As the air mass is forced downward on the leeward (east) side of the mountains, it is warmed and becomes more stable. In turn, the dried, warmer air promotes further evaporation from the landscape. As a result, higher elevations located near the crest of the Cascades receive the most precipitation, while lower elevation areas located to the east near the river bottom receive the least precipitation. The climate of Riverside and the rest of the Okanogan River valley is classified as semi-arid, while higher elevation areas have a humid continental climate. Annual total precipitation ranges from about 8 inches at the confluence of the Okanogan and Columbia Rivers, to more than 60 inches in the mountainous regions of the Pasayten Wilderness in the Cascades in the northwest portion of the basin in Washington State (Reference #2). Most precipitation falls between November and April as

snow, while summers are hot and dry (Reference #6). The mean annual temperature for the Okanogan Watershed as a whole is 49 degrees Fahrenheit, with average temperatures varying from 21 degrees Fahrenheit in January to 73 degrees Fahrenheit in July (Reference #2). In Omak, located about 8 miles downstream (south) of Riverside, the peak growing season occurs from May to September (Reference #6).

The hydrology of the Okanogan River basin is typical of other watersheds located on the east side of the Cascades. High runoff from snow melt and spring rains supplies most of the stream flow in spring and early summer, while low summer and early fall flows are due to lack of precipitation and a diminishing snow pack in the mountains. The Okanogan River typically experiences its peak flows during a 2 to 3 week period in late May to early June. These peak flows on average account for approximately one-half of the total annual runoff volume. Minimum stream flows usually occur in early fall to mid-winter, (September to March) (Reference #2). In arid climates such as the Okanogan Valley, most precipitation falling in the warmer months either evaporates or is absorbed into soils. Only a small percentage of this precipitation directly contributes to stream flow. Annual average discharge measured on the Okanogan River at Malott, Washington between 1967 and 2013 varied between about 1,300 cubic feet per second (CFS) in 2001 and 6,312 CFS in 1972 (Reference #7). The average annual flow at the Malott gage is approximately 3,000 CFS (Reference #1). Malott is located about 21 miles downstream (south) of Riverside.

As snow melts in late spring to early summer, a portion of the runoff infiltrates into the soil prior to reaching surface waters and becomes groundwater. Groundwater is very important in maintaining stream flow in the Okanogan River during drier periods of the year when runoff from snow melt and precipitation is not available. It's estimated that about 75 percent of the entire ground water supply in the basin is stored in the glacial sediment deposits found in the stream corridor and stream valleys. Ground water is also present in the area's highly fractured, folded, and faulted bedrock as well as in volcanic rocks in the south-central portion of the watershed. However, water from these underground sources is typically not abundant enough to produce adequate well yields (Reference #1).

As mentioned, most surface water delivered to the Okanogan River is supplied by tributaries originating in southern British Columbia. Most stream flow comes from the Okanagan (as it is known in Canada) and Similkameen Rivers. The Similkameen River contributes 75% of the flow to the Okanogan River (Reference #4). In addition, smaller surface water tributaries located in Washington such as the Bonaparte, Omak, Whinestone, Salmon, Sinlahekin, and Toats Creeks also contribute to streamflow. Important lakes and reservoirs in the watershed in Washington include Omak, Palmer, Conconully, Osoyoos, Spectacle, and Whitestone Lakes. The Columbia River is also an important water supply to the watershed (Reference #1).

## 2.5 Vegetation

Natural vegetation in the Okanogan Basin varies greatly, depending on elevation, aspect, and available precipitation. Generally, higher elevation areas with more abundant precipitation and cooler temperatures are heavily forested, while vegetation in drier, warmer lower elevation areas is primarily comprised of shrubs and grasses. South and east aspects are generally drier and warmer than north and west aspects at the same elevation. Riparian and wetland vegetation is found along shorelines and in other wet areas.

In the lowest elevation areas in valleys and terraces (from the outer edge of the floodplain to roughly 2500-foot elevation), shrubsteppe vegetation is present. Shrubsteppe vegetation is adapted to the semi-arid climate of the valley. Native shrubs and grasses include: sage brush, rabittbrush, bitterbrush, bluebunch wheatgrass, Idaho fescue, needle and thread grass, and Sandberg's bluegrass. Native shrubsteppe communities have been greatly altered and diminished since pre-European settlement due to overgrazing by livestock, conversion to agricultural uses, invasive species, and fire suppression (Reference #4).

Forests cover approximately 47 percent of the Okanogan Basin in Washington. Lower elevation forests above the shrubsteppe community consist primarily of Ponderosa Pine and Douglas-fir with a shrub, forb, or grass under-story (Reference #4). Western larch occurs with Ponderosa Pine and Douglas-fir at slightly higher elevations and wetter sites, while forests consisting of subalpine fir, Engelmann spruce and lodgepole pine with an understory of shrubs and forbs occur at elevations up to about 7,800 feet (Reference #5).

Dominant riparian species include black cottonwood, water birch, Mountain alder, and Sitka alder. Shrubs such as willows, red-osier dogwood, hackberry, mountain alder, Wood's rose, snowberry, and currant may also occur. At lower elevations, livestock grazing, agricultural conversions, altered stream morphology, and water withdrawal have reduced riparian vegetation (Reference #4).

Riparian vegetation provides many important benefits to the shoreline ecosystem. It helps to moderate stream temperature by providing shade, provides woody debris into streams which is needed for fish and wildlife habitat, inhibits sediment from entering streams by dissipating the energy of runoff thereby suppressing erosion, moderates stream flows by absorbing runoff and allowing it to gradually seep into streams, and provides food and shelter for numerous animal species. Riparian vegetation and soil bacteria also play an important role in detoxifying chemicals and animal waste prior to it reaching streams (Reference #8). This is an especially important function along the Okanogan River where much of the adjacent land has been converted to agricultural uses.

Several species of noxious weeds are known to occur in the Okanogan Basin. Noxious weeds are non-native plants that spread quickly and can be difficult to control. Their invasion causes both ecological and economic damages. Grazing, agriculture, and land disturbances have introduced these weeds into the basin. The shrubsteppe vegetation zone occurs in and around the Town of Riverside. A couple of noxious weeds that have become especially prevalent in this vegetation zone include Russian thistle (also known as tumbleweed) and cheatgrass (Reference #4). In agricultural areas, Russian thistle can reduce yield and quality of numerous crops, particularly alfalfa and small grains. It does this by depleting soil moisture, interferes with tillage operations, and provides food or shelter for insect pests and crop diseases. It also can threaten native plant ecosystems (Reference #9). Cheat grass out competes native grasses by quickly establishing large root systems in the spring, enabling it to remove most water in the uppermost layers of the soil just as native grass seedlings are becoming established. It also encourages wildfires by drying out earlier in the year than native species. Fires in turn kill native grasses and shrubs, thus impacting the habitat availability for native wildlife (Reference 10). The removal of vegetation due to fire also increases the potential for surface erosion. Knapweed is another particularly troublesome exotic species occurring in this zone. A detailed vegetation analysis is needed to determine the extent of noxious weed invasion in Riverside. Due to the widespread occurrence of weeds in the region, it is likely that some species occur within city limits and along the town's shoreline.

Figure 2: Regional Land Use and Land Cover shows various vegetation regimes and land uses within the Okanogan watershed, (forest, wetlands, shrubsteppe, and areas converted to agricultural uses).

### 2.6 Fish and Wildlife

The Okanogan River and tributaries are home to 25 indigenous fish species including 16 introduced fish species. The river is the uppermost Columbia River tributary currently accessible to anadromous and resident fish populations. Indigenous anadromous species include chinook, coho, and sockeye salmon, steelhead trout, and pacific lamprey. Its sockeye salmon population is one of only two viable populations left in the entire Columbia basin. Resident indigenous fish species include bull trout, rainbow trout, mountain whitefish, various species of sucker, sculpin, dace, and northern pikeminnow, to name a few. Introduced fish species include carp, smallmouth bass, yellow perch, and eastern brook trout. These species compete with native fish for food resources, habitat, and in some cases, even breed with native species. The eastern brook trout has been known to hybridize with bull trout which has resulted in the decline of bull trout in the Okanogan River Basin (Reference #4). Spring Chinook, summer steelhead, and bull trout are federally listed species in the basin. Summer Chinook utilize the river habitat in the vicinity of Riverside for spawning (Reference #11).

One type of human activity that has limited rearing habitats for juvenile salmonids and possibly impacted salmon spawning habitat in the Okanogan Basin is the construction of dams and levees. These structures limit the stream's ability to migrate into its floodplain and constrict the channel, which causes increased stream velocities during high flows and scouring. Juvenile salmonids utilize sloughs and backwaters where water velocities are lower for overwintering habitat. Such habitat has been limited by channel/flood control structures. In addition, salmon that spawn in areas subject to scouring may have reduced egg to fry survival (Reference #12).

The Okanogan Basin is home to hundreds of species of birds, mammals, reptiles, and amphibians. A total of 9 species of amphibians are known to occur in the basin, 222 species of birds, 86 species of mammals, and 13 species of reptiles. In addition to providing habitat for many species, the basin also serves as an important migratory corridor for megafauna and birds. Mule deer utilize the north-south river corridor to migrate between the dry landscapes of the interior of British Columbia to the grasslands in the south. Several species of birds utilize the corridor during annual migrations between winter and summer ranges (Reference #4).

The Washington Department of Fish and Wildlife (WDFW) classifies certain habitats and species determined to be priorities based on defensible criteria. In the Riverside area, three such priority species are known to occur: mule deer, golden eagles, and bald eagles. There is a regular concentration of mule deer in the area throughout the year, and the area provides important breeding habitat for golden and bald eagles. While bald eagles were removed from the Federal List of Endangered and Threatened species in 2007, they remain classified as a federal species of concern and are also classified as a sensitive species in Washington State (Reference #11).

### 2.7 Cultural Factors

Humans have lived in the Okanogan River basin for at least the last 7,000 years. Up until the mid-1800's, native peoples were nomadic, moving from place to place to occupy fishing sites and to harvest native plants and berries. At least five bands of the Okanogan tribe (at least 7 additional bands lived north of

the international border) lived south of what would become the US/Canadian border, and their territory stretched from the crest of the Cascades to about 100 miles to the east. The harvest of seasonal runs of salmon on the Okanogan River was a very important food source, and important fishing areas were located near Oroville, Monse, Malott, and Omak. Today, the descendants of the native peoples in the US are enrolled in the Colville Tribes Reservation. Tribal members continue to utilize many food resources in their territory, including salmon from the river, camas roots, and berries (Reference #4).

European and European-American trappers and traders began appearing in the area in the early to mid-1800s. Additional people moved to the area upon the discovery of gold in the late 1800s. Many boom towns sprang up during this period. Over time, the mining industry was gradually replaced with farming and ranching. Riverside was first settled in the late 1800s, and was the upstream limit of navigation during the spring high water season. Paddle-wheel riverboats traveled up the Okanogan to Riverside to off-load both goods and settlers during the town's settlement period. Riverside was officially incorporated on December 22, 1913. The Great Northern Railroad was built in the region in 1914, replacing the paddle wheelers as the primary transportation. The relatively fast and reliable railroad service to the area allowed for the expansion of irrigation systems throughout the river valley. This allowed for the conversion of more lands to agricultural uses and for the permanent establishment of communities (Reference #4).

### 2.8 Land Ownership, Uses, and Cover

The ownership of lands in the US portion of the Okanogan watershed are comprised of public, tribal, and private interests. Approximately 41% of the land area is owned by public agencies (State of Washington, US Forest Service, US Bureau of Land Management), 34% are private lands, and 25% is land owned by the Colville Indian Reservation (Reference #12). The dominant land uses in the watershed are forestry and range followed by cropland. Residential developments have been established in many areas, from the river valley bottom to the uppermost forests (Reference #4). Most cities in the basin are located along the river corridor. Major cities include Omak, Okanogan, Oroville, and Brewster. The estimated total population as of 2013 for Okanogan County, which includes the Okanogan and Methow river sub-basins, was 41,193 (Reference #13).

Forest lands cover approximately 47% of the Okanogan River basin in Washington and are owned by public and private groups (Reference #2). Most of these forests lie within the Pasayten Wilderness and Okanogan National Forest and are managed by the US Forest Service (USFS). The Washington Department of Natural Resources (DNR) manages the Loomis State Forest located about 12 miles west of Tonasket. Forest lands are utilized for timber production, livestock grazing, and mining. Timber production for the Okanogan National Forest increased from World War II until the mid-1960s but has since fallen off. Forest productivity in the basin is fairly low due to low precipitation, short growing season in high elevation areas, and steep, rocky terrain (Reference #4).

Rangelands cover about 754,996 acres of the Okanogan basin in Washington. Rangelands are managed by several groups including the USFS, Bureau of Land Management (BLM), DNR, Colville Tribes, and private owners. Cattle are grazed at higher elevations in the summer on state, federal, and private lands, and are often moved to lower areas within the Okanogan River floodplain in the winter. Small flocks of sheep, goats, and horses are also grazed on private lands in the lower basin (Reference #4). Livestock is grazed adjacent to portions of Riverside's shoreline, (a few horses and cattle).

Croplands are primarily located in the Okanogan River valley where soils are more productive, water is more readily available, and the climate is the most favorable for crop growth. A variety of crops are grown in the watershed in Washington, including: cereal grain (primarily wheat but also spring barley and oats), grass hay or grass/legume (mixed alfalfa, clover, and grass) hay, tree fruit (apples, pears, cherries), and to a more limited extent vegetables, berries, and nuts. Due to the semi-arid climate of the river valley, most crops must be irrigated. A total of nine irrigation districts, reclamation districts, or canal companies deliver irrigation water from surface water sources to about 24,710 acres in the basin (Reference #2). Grass hay, alfalfa, and tree fruit crops are raised in Riverside and vicinity.

Mining is another land use that occurs on a more limited extent in the Okanogan basin. The extraction of non-metallic minerals such as sand, gravel, gypsum, and limestone is more extensive than hard rock mining. The USFS, Okanogan County, DNR, and private landowners maintain gravel mining operations in the basin (Reference #4). A large amount of crystalline limestone deposits are known to occur in areas west and northwest of Riverside. A local company that produces organic fertilizer products extracts calcium from such deposits just outside of city limits, near the southwest corner of town.

Figure 2: Regional Land Uses and Land Cover provides an overall breakdown of cover and uses in the entire watershed, while Figure 7: Existing Land Cover and Figure 8: Existing Land Use highlight uses and cover within the Town of Riverside city limits.

### 2.9 Water Quality

Water quality problems have been noted in the watershed in Washington in recent years. Quality standards for temperature, pH, turbidity, and fecal coliform have been noted in the Okanogan River main stem, as well as in some tributaries. Contamination from organic pollutants such as Dichlorodiphenyltrichloroethane (DDT), related compounds (DDE, DDD, etc.) and polychlorinated biphenyls (PCBs) remain a problem in isolated areas, but are not thought to be a problem basin-wide. However, the river and several tributaries are on Washington State's 303(d) list of impaired waters because they do not meet the EPA human health criteria for DDT and PCBs in edible fish tissue, as well as for non-attainment of the state's chronic criteria for DDT in water. The sources of these contaminants are from historic agricultural and industrial activities. Metal contamination has been noted on one tributary, Tunk Creek, which enters the Okanogan River just upstream of Riverside. Metal contamination does not appear to be a basin-wide problem, but more sampling and studies are needed in other tributaries. Dissolved oxygen is of concern in many tributaries including lower Tunk Creek, Salmon Creek, Johnson Creek, Bonaparte Creek, Antoine Creek, Tonasket Creek, and Ninemile Creek. Lack of oxygen in streams can have a severely adverse effect on aquatic systems ability to support life (Reference #2).

Salmonids depend on cool, well-oxygenated water for their survival. Dissolved oxygen decreases as stream temperatures increase. Temperatures between 73 and 77 Fahrenheit are lethal to salmon and steelhead, and temperatures above 51.8 Fahrenheit cause mortality and genetic abnormalities of salmon eggs. The Okanogan River often exceeds the lethal tolerance for salmonids in the mid to late summer. The river temperature is raised due to natural causes (low gradient and solar radiation on upstream lakes) but is made worse by sedimentation and low flows as a result of irrigation and dam operations. Stream temperature problems are not regularly noted in a few heavily forested tributaries which include Chiliwist, Tallant, Johnson, Siwash, and Loup Loup creeks. It is thought that the presence of riparian vegetation helps to lower stream temperatures in these tributaries (Reference #12).

Increased erosion and sedimentation can contribute to increased stream temperature by forming shallower and wider streams that exposes additional area to direct sunlight (Entrix and Golder 2004). Sedimentation can also cause problems for salmonid reproduction by covering spawning gravels and smothering eggs. Several factors contribute to erosion and sedimentation in the Okanogan River, some of which include: high runoff from adjacent steep terrain, removal of riparian vegetation due to land conversions and grazing, construction of impervious surfaces in developed areas (roads, roofs, etc.), and loss of vegetation due to fire, logging, and over grazing. Roads are thought to be the greatest contributing source of sediment to streams in the basin. The removal of vegetation and construction of impervious surfaces increases soil erosion potential by increasing storm runoff volumes and velocities and by limiting infiltration into soils. Riparian vegetation is especially important to the prevention of erosion along streams because it maintains masses of living roots which reduce surface erosion by holding soil in place. It also helps to mitigate runoff to streams by increasing void space in soil through root growth which allows for greater runoff retention (Reference #12).

Structures such as dikes and levees can also increase erosion and sedimentation by limiting a stream's ability to migrate laterally into its floodplain. Dikes and levees constrict the channel which increases stream velocity during periods of high flow. High energy flows can lead to accelerated bank erosion and stream down cutting (Reference #12). Much of the Okanogan River has been channelized through the construction of flood/channel control structures. A dike is present along much of Riverside's shoreline, extending approximately 700 feet downstream of the bridge crossing (Reference #30). It is not known how the dike impacts bank erosion and sedimentation within the town's shoreline. Further study is required.

Soils most prone to erosion in the basin are the Colville silt loams and the Bosel fine sandy loams (Reference #12). Colville silt loams are classified as a poorly draining soil, and are present along portions of Riverside's shoreline. See Figure 9: Soil Type, for the locations of these soils and others within Riverside city limits.

Fecal coliform counts fairly often exceed standards in the Okanogan River main stem, and in some of its tributaries, most notably Bonaparte and lower Sinlahekin Creek. Sampling has shown that counts are highest between May and October. It's possible that greater direct contact to water by livestock and wildlife during this time of year may account for the elevated counts (Reference #2).

Samples taken from the Okanogan River in recent years shows that the pH exceeds a neutral reading of 7, indicating uniformly alkaline waters. It is not known if the pH is affected by land use activities (Reference #2). Johnson Creek, which enters the Okanogan River at Riverside, is classified as a 303(d) stream by the State of Washington for high pH as part of the state's 2012 Water Quality Assessment. The federal Clean Water Act requires that all states restore their waters to be "fishable and swimmable." Section 303(d) of the Clean Water Act established a process to identify and clean up polluted waters. Waters given the 303(d) list designation in Washington are water bodies that fall short of state surface water quality standards (Reference #14).

### 2.10 Measures to Protect and Restore Ecosystem-Wide Processes

Some of the ecosystem-wide issues identified in the summary include loss of riparian vegetation, invasion of non-native noxious weeds, disconnection of the river channel with adjacent flood plains and wetlands, and water quality problems (high stream temperatures, turbidity, fecal coliform, pH, organic

pollutants, and metal pollutants). The Okanogan Watershed Plan (2009), the Okanogan County Regional Shoreline Master Program (2009), and the Okanagan Subbasin Plan (2004) all provide many useful recommendations to protect and restore eco-system wide processes important to maintaining ecologically functioning shorelines. Many of these recommendations could be applied directly to Riverside's shoreline. The following is a brief summary of potential restoration and protection opportunities that are focused on the identified ecosystem-wide issues:

**Riparian and Wetlands:** Fencing can be placed around and adjacent to riparian and wetland areas to prevent livestock grazing, and to control livestock access points to water bodies. In addition to protecting native riparian vegetation and reducing bank erosion and sedimentation, limiting livestock access to riparian areas has the added benefits of reducing fecal coliform pollution and minimizing the establishment of noxious weeds.

New development projects can be regulated to prevent encroachment of riparian and wetland habitat through the use of buffers and adequate shoreline setbacks for construction.

Local conservation groups could be encouraged to develop a comprehensive map showing known wetlands and areas where geology, geography, and hydrology would likely contribute to functioning wetlands. The information developed in this process could then be used to prioritize wetland development opportunities. Existing wetland areas could be augmented to increase their capacity or new wetlands could be constructed where feasible.

Vegetation surveys could be conducted by land managers and conservation groups in riparian areas to identify the presence and prevalence of non-native weed species so that plans could be formulated to limit their spread. These surveys would also be useful to identify areas that would most benefit from plantings of native vegetation.

**River Channel and Floodplain Connectivity, Side-Channel Habitat:** Off-channel/side channel alcoves, ponds, wetlands, and seasonally flooded areas that are still connected to the river channel could be protected from new development projects by zoning ordinances and regulations that limit construction in these areas or require mitigation efforts.

Where feasible, barriers such as dikes and levees could be breached and/or culverts could be installed to re-establish connectivity.

Opportunities for side channel habitat establishment have been greatly limited in the Okanogan River due to the widening of the river channel and increased sediment levels. However, where possible, side channel habitat will provide critical habitat for aquatic species and increase hydrologic function. To provide better opportunities for side channel habitat, stream banks could be stabilized to minimize further erosion and sedimentation. Traditional techniques for bank stabilization such as rip rap, retaining walls, and sheet piles can be used, but these methods can be expensive, ineffective, and prohibit the establishment of healthy riparian vegetation. In lieu of hard structure methods, bioengineering techniques which use a combination of structural practices and live vegetation should be encouraged. Because bioengineering techniques utilize live vegetation, they can also improve wildlife habitat and water quality in addition to stabilizing soils.

**Water Quality:** Some of the opportunities already mentioned, such as the protection and restoration of riparian vegetation and the stabilization of stream banks can greatly improve water quality. Riparian

vegetation provides shade needed to regulate stream temperatures and filters pollutants from storm and agricultural runoff. It also helps to reduce erosion and sedimentation by dissipating runoff energy and stabilizing stream banks. So any methods that protect and restore riparian vegetation will also contribute to better water quality and should be utilized whenever possible. Landowners should be encouraged to voluntarily improve riparian vegetation and stream shading by conservation groups and agencies. The development of voluntary riparian conservation easement programs along the Okanogan River and tributaries could also be explored by local groups and Okanogan County as a mechanism to improve water quality.

New development projects within and adjacent to the shoreline can be regulated to comply with state storm water policies, and require that storm runoff be routed through storm detention/settling ponds or other methods for treatment prior to discharge to surface and/or ground waters. The Eastern Washington Stormwater Manual provides guidance on best management practices for storm runoff treatment and minimization of erosion losses from developments and construction sites. Zoning and shoreline regulations could also be utilized to minimize development in areas of highly erosive soils.

Public education on the effects of fertilizers, pesticides, and septic tanks on the shoreline ecosystem may also be useful, especially for shoreline residents. Local conservation groups and cities could also organize shoreline cleanup volunteer projects to remove trash detrimental to water quality and wildlife habitat. These types of projects have the added benefit of generating greater awareness and concern for shoreline ecosystems and water quality issues through hands-on efforts by the citizens who live and work along the Okanogan River and tributaries.

# 3 Reach Inventory and Analysis

## 3.1 Shoreline Jurisdiction and Reach Breaks

Several sources were used to map the shoreline jurisdiction reaches as shown on Figures 11 and 12 in the appendix. The Town of Riverside city limits was obtained from GIS data available on the Department of Ecology's GIS website. Property ownership parcels, street right of way, and land use was obtained from Okanogan County. Wetlands were mapped based on National Wetland Inventory information, while creek and river boundaries were obtained from the USGS National Hydrography Dataset. Soils information was gathered from metadata retrieved from the US Department of Agriculture, Natural Resources Conservation Service web site. The Washington Department of Fish and Wildlife Priority Habitats and Species (PHS) on the Web interactive map was used to determine priority habitats and species that may be present in the Riverside area.

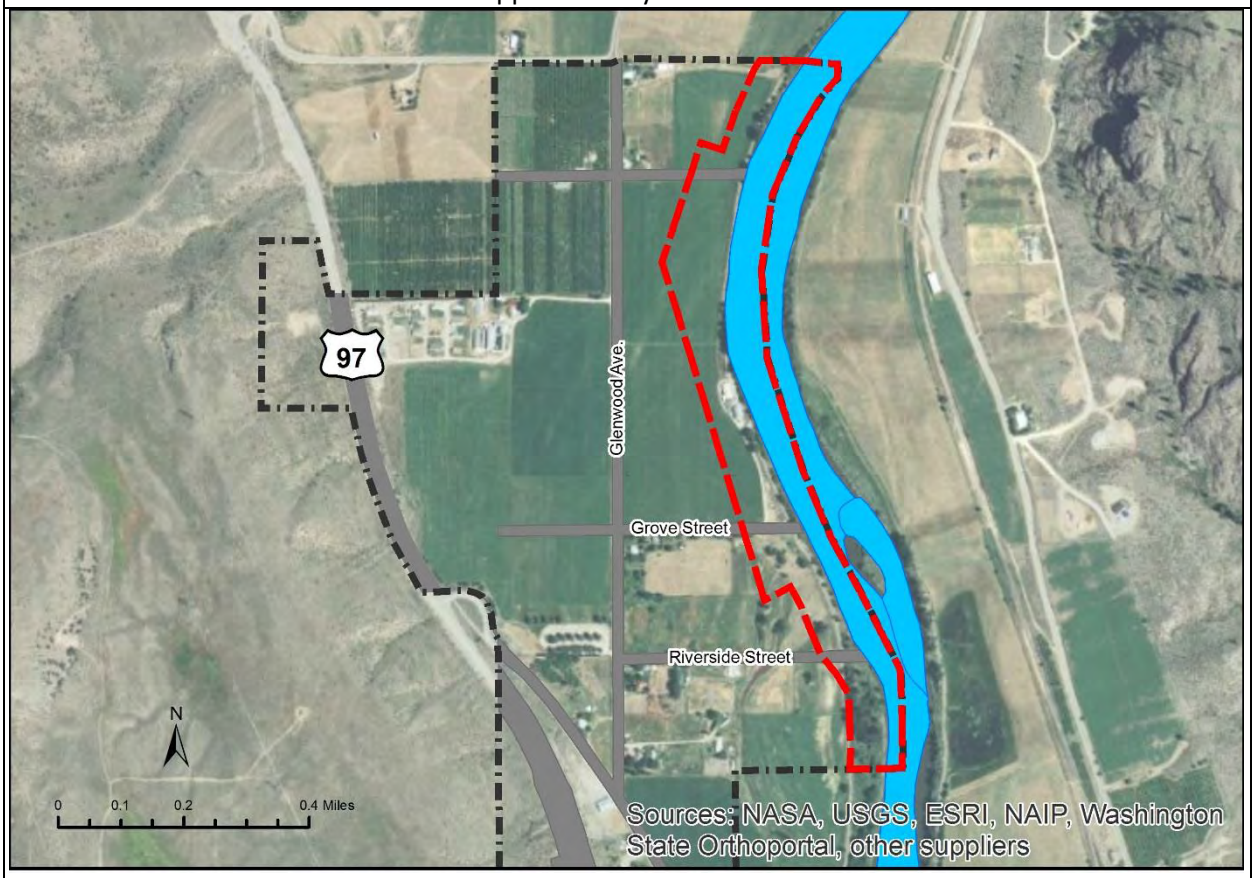
Observations made by Forsgren Associates staff during a site visit in August of 2014 as well as aerial photo data was also relied upon to complete the shoreline inventory.

For the purposes of the inventory, wetlands located within the 100-year floodplain of the river shoreline or within 200 feet of the OHWM or floodway are included in the shoreline reach areas. To categorize distinct reaches of the Town's shorelines for characterization, the shoreline jurisdiction was classified into three preliminary reaches based primarily on general land uses. The following section provides a summary of each delineated reach.

## 3.2 Shoreline Characterizations and Assessments

### 3.2.1 Reach 1 Summary

| **Okanogan River** | **Town of Riverside** |
|---|---|
| Reach 1 | Reach Length: 0.9 miles |
| Shoreline Jurisdiction Area in Reach 1: Approximately 26 acres. | |




**Description:** Okanogan River and shorelands within the incorporated Town of Riverside.

**Reach 1, see Figure 11:** Begins at the north city limit boundary and extends south approximately 0.9 miles to the city limit boundary.

**Physical Characteristics**

**Ownership:** The reach is owned by three private landowners.

**Existing Land Cover / Development:** The majority of the reach is comprised of agricultural lands, with a smaller area of undeveloped lands at the southern portion of the reach. There is one residential home located near the mid-point of the reach. Crops grown on agriculatural lands consist primarily of grass/legume hay (alfalfa) and cereal grains. The undeveloped lands located on the south portion of the reach consist primarily of shrub steppe and freshwater forested / shrub wetland habitats.

| **Okanogan River** | **Town of Riverside** |
|---|---|
| **Land Use Designation / Current SMP:**<br>• Agriculture: Approximately 19 acres. (Note: The residential home is located on county defined agricultural lands.)<br>• Undeveloped: Approximately 6 acres.<br>• Road Right of Way: Approximately 1 acres.<br>Current SMP environmental designation: Not applicable. | |
| **Major Infrastructure:** Grove Street and a driveway to a residential house off of this street cross the shoreline jurisdiction in the reach. Two additional roads, Riverside Street to the south and Hazel Street to the north, are platted streets but are undeveloped. | |
| **Geomorphic Character:** In Reach 1, the channel is confined and incised within alluvium and glaciolacustrine soil deposits, (Colville silt loam and Tonasket silt loam, respectively). The river channel does exhibit an anabranching channel pattern near the southerly portion of the reach, where the channel contains two flow paths around a small island.<br><br>**Hardened banks:** Small areas of rip rap are present on the river bank in the vicinity of the residential home.<br><br>**Channel Migration Zone (CMZ) Characterization:** In Reach 1, a dike is present along the entire length of the shoreline. The CMZ is limited by the dike. The dike was constructed to provide flood protection for the residential home and agricultural areas. No culverts or other structures that might be used to connect the river channel with the adjacent flood plain were observed during a site visit. | |
| **Flooding and Geological Hazards:** The entire reach is located within the 100-year flood plain.<br>Two types of soils are present within the reach: Tonasket silt loam and Colville silt loam. Both soils are rated as having a slight erosion potential when exposed due to various land use activities such as grazing, mining, road construction, and other kinds of disturbance. A rating of “slight” indicates that erosion is unlikely under ordinary climatic conditions. The soils have a moderate erosion susceptibility to sheet and rill erosion by water. Colville silt loam has a flooding frequency class rating of occasional, while Tonasket silt loam has a rating of none. The flooding frequency refers to the likelihood of a soil type to periods of temporary inundation caused by overflowing streams and runoff from adjacent slopes. A rating of “occasional” means that flooding occurs infrequently under normal weather conditions, and the chance of flooding is 5 to 50 percent in any year. A rating of “none” means that flooding is not probable. Colville silt loam has a drainage class rating of poorly drained, while Tonasket silt loam has a rating of well drained. | |
| **Reach Characterization and Analysis** | |
| **Water Quantity and Sediment:** Peak flows in the Okanogan River typically occur during a 2 to 3 week period in May to early June during the spring snowmelt. Lowest stream flows occur in summer and early fall due to nearly absent precipitation and diminishing snowpack. Irrigation practices may subsequently reduce summer flows. In Riverside, irrigation water is diverted from the river to support agriculture during the summer months.<br><br>The river section at Riverside contains a high portion of sand and silts due to input from upstream land uses and disturbances and low river gradient and velocity. | |
| **Water Quality:** There is a 303d listing for DDT and PCBs in the Okanogan River. Temperature, pH, turbidity, and fecal coliform water quality problems have also been noted. | |

| **Okanogan River** | **Town of Riverside** |
|---|---|

**Habitat Characteristics and PHS Species Presence:**

**Vegetation** - Riparian areas in the reach support native tree species such as: Black cottonwood (*Populus trichocarpa*), Mountain alder (*Alnus incana*), Sitka alder (*Alnus sinuate*), and Water birch (*Betula occidentalis*). Non-native tree species such as elm and locust also occur. Native riparian shrub species include: willows, dogwood, spirea, hawthorn, and rose. Grasses occur in cleared areas and near the shoreline. Noxious weed species might also exist in this reach, especially in disturbed areas. This reach has limited tree cover and sources for large woody debris (LWD) recruitment. Riparian zone vegetation generally varies between 20 and 50 feet wide, however portions of the central and southerly reach are almost entirely devoid of riparian vegetation in some places. The most extensive riparian vegetation and tree cover occur at the southern end of the reach in undeveloped areas. Agricultural vegetation dominates adjacent to the riparian zone, although remnant shrubsteppe vegetation consisting of sagebrush, rabbitbrush and native grasses occur in scattered locations.

**Wetlands** – Small areas of freshwater emergent wetlands are found within the 100-year flood plain of the reach. An area of freshwater forested/shrub wetland is also found at the southerly portion of the reach adjacent to the river. There are approximately 7 acres of wetlands in the reach. A dike constructed along the entire reach limits the connectivity of the river channel to the wetlands

**Wildlife Species** – There are regular concentrations of mule deer in the area. The reach provides breeding habitat for Golden eagles, Bald eagles, Columbia Sharp-tailed Grouse, and cavity-nesting ducks. The river supports migratory habitat for native anadromous fish species including Steelhead, Chinook salmon, and Sockeye salmon, and also for native resident species including Rainbow trout and Pygmy whitefish. The river in the vicinity of Riverside is an important Summer Chinook breeding area. Non-native fish species such as smallmouth bass and carp may also occur.

**Ecological Functions Analysis – Reach 1**

**Level of Existing Function:** Functioning

**Stressors:** An existing dike limits flood plain and wetland connectivity with the river channel. Riparian vegetation is limited and has been almost entirely removed at some locations.

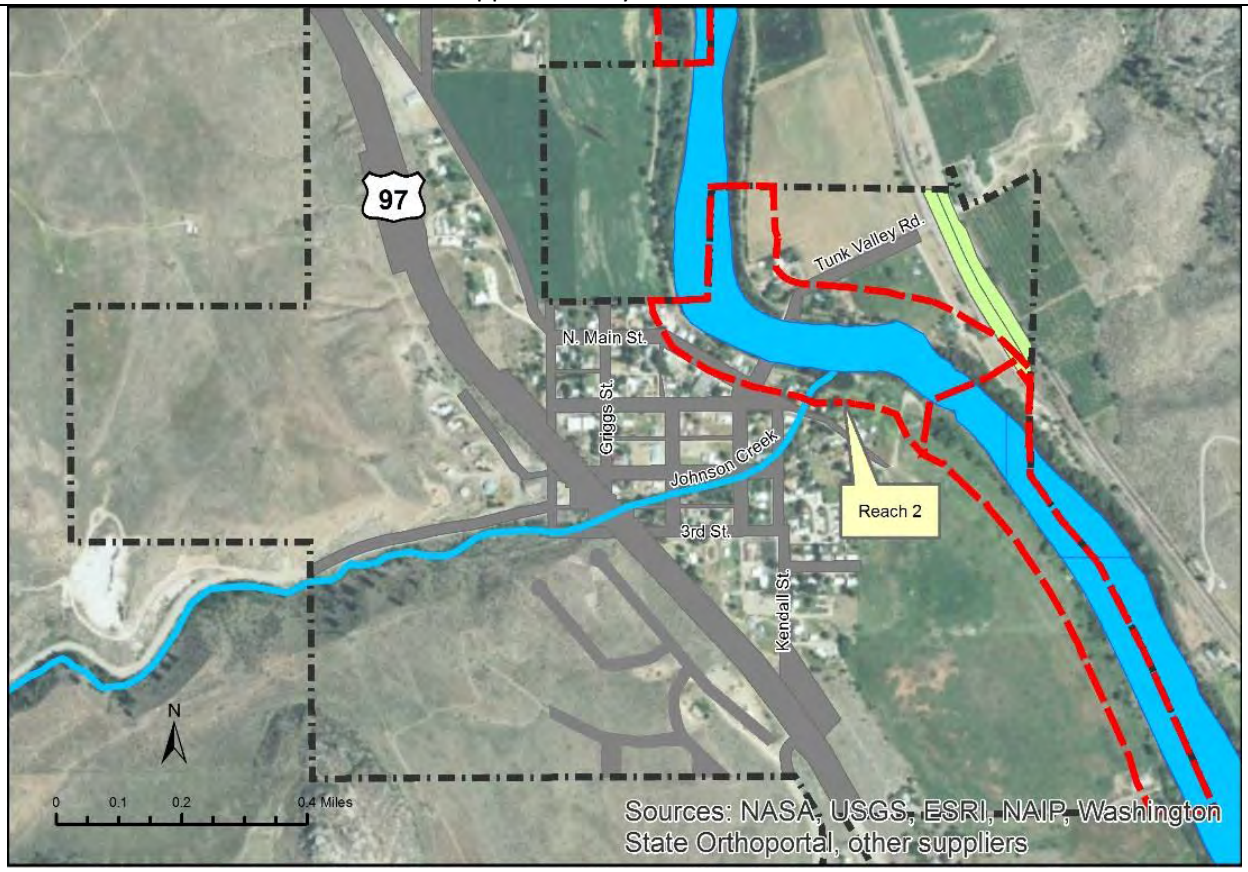
**Potential Stressors:** Further riparian vegetation removal, expansion of non-native invasive weed species, introduction of livestock grazing in agricultural areas adjacent to the riparian zone, future development of roads in the shoreline jurisdiction, (Hazel, Grove, and Riverside Streets). Herbicide, pesticide, and fertilizer runoff from agricultural fields.

**Potential Restoration Opportunities:** Work with private landowners to voluntarily restore native riparian vegetation needed to filter sediments and contaminants from agricultural fields and to provide large woody debris (LWD) recruitment. Utilize bioengineering techniques in combination with live vegetation to stabilize stream banks and reduce sedimentation. Work with local land managers and conservation groups to conduct vegetation surveys to identify the extent of invasive weed species so that a plan can be implemented to control their spread. Remove portions of the dike and/or install culverts to reconnect the river channel with the flood plain and wetlands. Careful planning would be necessary to determine the potential hazards to homes, structures, and agricultural lands by breaching/removing the dike.

| **Okanogan River** | **Town of Riverside** |
|---|---|
| **Potential Protection Opportunities:** If livestock were introduced to agricultural lands in the reach in the future, fencing could be installed to prevent livestock grazing inside the riparian zone and to control livestock access points to the river. Any future developments, such as the extension and development of roads, should be required to follow the storm water and erosion control measures defined in the Stormwater Manual for Eastern Washington. Limit future development to areas outside of wetland and riparian areas. | |
| **Preliminary Shoreline Environment Designation Considerations:** Apply designation(s) that allow for continuation of existing agricultural and maintain/protect existing riparian zone and wetland areas. An environmental designation of Rural-conservancy may be appropriate for Reach 1. | |
| **Public Access** | |
| **Existing Public Access:** There are no existing public access locations within Reach 1. | |
| **Existing Public Access Goals:** No specific goals have been identified by the Town of Riverside for Reach 1. | |
| **Identified Public Access Improvements:** No specific public access plans have been identified in the reach, although the development of Hazel, Grove, and Riverside Streets could potentially provide public access if these roads were developed in the future. | |

### 3.2.2 Reach 2 Summary

| **Okanogan River** | **Town of Riverside** |
|---|---|
| Reach 2 | Reach Length: 0.6 miles |
| Shoreline Jurisdiction Area in Reach 2: Approximately 19 acres. | |




**Description:** Okanogan River and shorelands within the incorporated Town of Riverside.

**Reach 2, see Figure 12:** Begins at the city limit boundary just upstream from the Tunk Valley Road bridge and extends south about 0.6 miles to the WDFW boat ramp.

**Physical Characteristics**

**Ownership:** The majority of the parcels in the reach are owned by private parties. The Town of Riverside owns a parcel near the north end of the reach, which it manages as a city park. The Washington Dept. of Fish and Wildlife owns a parcel at the south end of the reach, and manages the parcel for a public boat ramp.

**Existing Land Cover / Development:** Reach 2 is located within the downtown area of Riverside, where the majority of the land has been developed for residential and commercial purposes. This reach represents the most heavily developed portion of the Shoreline Jurisdiction. In addition to residential and commercial areas, there are some agricultural lands on the east side of the river, and public lands on the west side of the river, (WDFW boat ramp, Town of Riverside city park). A narrow riparian buffer zone is present along most of the reach between the river and residential, commercial, and agricultural areas.

| **Okanogan River** | **Town of Riverside** |
|---|---|

**Land Use Designation / Current SMP:**

- Residential: Approximately 11 acres.
- Commercial: Approximately 0.9 acres.
- Agriculture: Approximately 3.3 acres.
- Public Lands: Approximately 1.4 acres
- Undeveloped: Approximately 0.6 acre
- Road Right of Way: Approximately 1.5 acres
- Railroad Right of Way (Cascade and Columbia Railroad): Approximately 0.3 acres

Current SMP environmental designation: Not applicable.

**Major Infrastructure:** Portions of North Main Street and Tunk Valley Road cross the jurisdiction reach. The Tunk Valley Road bridge, the only bridge over the Okanogan River in the town's city limits, is located in the reach.

**Geomorphic Character:** In Reach 2, the channel is confined and incised within alluvium (Colville silt loam), glaciolacustrine (Tonasket silt loam), and glacial outwash (Pogue Gravelly fine sandy loam) soil deposits.

**Hardened banks:** No significant hardened banks were observed during the site visit and aerial photo inspection.

**Channel Migration Zone (CMZ) Characterization:** In Reach 2, a dike is present on the west side of the river from the north boundary of the reach to at least 500' downstream of the bridge. It is difficult to determine if the dike continues downstream from this location. The dike was constructed to provide flood protection for the town, and limits the CMZ. On the east side of the river, a dike is present along the entire reach and also limits the CMZ. According to city staff, the area in the vicinity of the boat ramp often floods every year, so it is likely the dike is not present in this area. The river channel may be able to access the adjacent flood plain at the south end of the reach.

**Flooding and Geological Hazards:** The majority of the reach is located within the 100-year flood plain, although a small area on the east side of the river is located in an area between the 100-year and 500-year flood. As mentioned, city staff has stated that the area in the vicinity of the boat ramp at the south end of the reach is known to flood annually. Properties subject to flooding include the boat ramp parcel and a residential parcel to the immediate north.

Four types of soils are present within the reach: Tonasket silt loam, Colville silt loam, Pogue Gravelly fine sandy loam, and Pogue fine sandy loam. Colville, Tonasket, and Pogue fine sandy loam soils are rated as having a slight erosion potential when exposed due to various land use activities such as grazing, mining, road construction, and other kinds of disturbances, while Pogue gravelly fine sandy loam is rated as moderate. A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions, while a rating of "moderate" indicates that some erosion is likely and that erosion control measures are needed. Colville silt loam has a flooding frequency class rating of occasional, while the other soils in the reach have a rating of none. The flooding frequency refers to the likelihood of a soil type to periods of temporary inundation caused by overflowing streams and runoff from adjacent slopes. A rating of "occasional" means that flooding occurs infrequently under normal weather conditions, and the chance of flooding is 5 to 50 percent in any year. A rating of "none" means that flooding is not probable. Colville silt loam has a drainage class rating of poorly drained, Tonasket silt loam has a rating of well drained, and the Pogue soil types are rated as somewhat excessively drained.

| **Okanogan River** | **Town of Riverside** |
|---|---|
| **Reach Characterization and Analysis** | |
| **Water Quantity and Sediment:** Peak flows in the Okanogan River typically occur during a 2 to 3 week period in May to early June during the spring snowmelt. Lowest stream flows occur in summer and early fall due to nearly absent precipitation and diminishing snowpack. Irrigation practices may subsequently reduce summer flows. In Riverside, irrigation water is diverted from the river to support agriculture during the summer months.<br><br>The river section at Riverside contains a high portion of sand and silts due to input from upstream land uses and disturbances and low river gradient and velocity. | |
| **Water Quality:** There is a 303d listing for DDT and PCBs in the Okanogan River and for pH in Johnson Creek. Johnson Creek enters the river within Reach 2. Temperature, pH, turbidity, and fecal coliform water quality problems have also been noted in the river. | |
| **Habitat Characteristics and PHS Species Presence:**<br><br>**Vegetation** - Due to somewhat extensive development present within Reach 2, there is limited habitat available for plants and wildlife. However, the narrow riparian zone within the reach does support many tree, shrub, and grass species and is important for wildlife. Tree species found in the riparian zone include: Black cottonwood (*Populus trichocarpa*), Mountain alder (*Alnus incana*), Sitka alder (*Alnus sinuate*), and Water birch (*Betula occidentalis*). Non-native tree species such as elm and locust also occur. Native riparian shrub species include: willows, dogwood, spirea, hawthorn, and rose. Grasses occur in cleared areas and near the shoreline. Noxious weed species might also exist, especially in disturbed areas. This reach has limited tree cover and sources for large woody debris (LWD) recruitment. Riparian zone vegetation generally varies between 20 and 80 feet wide. Areas adjacent to the boat ramp are largely devoid of trees. The west side of the river has more extensive riparian vegetation than the east side. Vegetation adjacent to the riparian zone is comprised mainly of grassy lawns, ornamental landscaping, and agricultural fields. Most riparian vegetation is absent in and around the mouth of Johnson Creek. This may be due to foot traffic in the area.<br><br>**Wetlands** - There are no known wetlands within Reach 2.<br><br>**Wildlife Species** - There are regular concentrations of mule deer in the area. The reach provides breeding habitat for Golden eagles, Bald eagles, Columbia Sharp-tailed Grouse, and cavity-nesting ducks. The river supports migratory habitat for native anadromous fish species including Steelhead, Chinook salmon, and Sockeye salmon, and also for native resident species including Rainbow trout and Pygmy whitefish. The river in the vicinity of Riverside is an important Summer Chinook breeding area. Non-native fish species such as smallmouth bass and carp may also occur.<br><br>According to WDFW fish passage barrier data, Johnson Creek has culverts and small dams upstream from the Shoreline Jurisdiction area within city limits that are impassable to fish. A study conducted by the Colville Tribes Department of Fish and Wildlife Anadromous Fish Division – Omak Office in January 2007, found that Johnson Creek between Highway 97 and the confluence with the Okanogan River is intermittent and occasionally flows subsurface. Physical surveys conducted in 2004 identified the creek substrate was composed of mostly clay and large cobble which provide only marginal spawning habitat for salmonids. Snorkel surveys conducted in 2004 did not observe any fish. Based upon field observations of no fish, marginal spawning habitat and high stream gradient, the study recommended that no barrier surveys were warranted upstream of Highway 97. | |

| **Okanogan River** | **Town of Riverside** |
|---|---|
| **Ecological Functions Analysis – Reach 2** | |
| **Level of Existing Function:** Functioning<br><br>**Stressors:** An existing dike limits flood plain connectivity with the river channel. However, the dike is likely needed to protect homes and businesses from flooding. Riparian vegetation is limited in all areas and has been largely removed in around the mouth of Johnson Creek near the river bank and in a few areas on the east bank of the river.<br><br>**Potential Stressors:** Further riparian vegetation removal and residential/commercial development. Herbicide, pesticide, and fertilizer runoff from adjacent residential yards and agricultural areas. Non-point source pollution from adjacent roads.<br><br>**Potential Restoration Opportunities:** Work with private landowners, the city, and WDFW to voluntarily restore native riparian vegetation needed to filter sediments and contaminants and to encourage large woody debris (LWD) recruitment. Utilize bioengineering techniques in combination with live vegetation to stabilize stream banks and reduce sedimentation. Work with local land managers and conservation groups to conduct vegetation surveys to identify the extent of invasive weed species so that a plan can be implemented to control their spread. Storm water diversions or containment ponds could be used to protect the river from non-point source pollution runoff from adjacent development. Existing storm water discharges could be retrofitted with containment ponds, settling basins, and oil/water separators to reduce non-point source pollution entering the river. Such efforts would need to be coordinated between state and county agencies as well as the Town of Riverside.<br><br>**Potential Protection Opportunities:** Any future developments should be required to follow the storm water and erosion control measures defined in the Stormwater Manual for Eastern Washington. Limit future development to areas outside of riparian and frequently flooded areas. Zoning and shoreline regulations could be utilized to require setbacks from riparian areas for new development. Organize volunteer community stream bank litter pick-up events. Promote public education on fertilizer, pesticide, and herbicide impacts especially for shoreline residents and businesses. | |
| **Preliminary Shoreline Environment Designation Considerations:** Apply designation(s) that allow for continued existing uses. An environmental designation of Rural-conservancy may be appropriate for agricultural areas within Reach 2. Areas on the west bank of the river are comprised primarily of residential with some commercial uses, and so an Urban Commercial designation may be appropriate. Residential areas on the east bank of the river might be designated as Shoreline Residential. | |
| **Public Access** | |
| **Existing Public Access:** Within Reach 2, public access locations exist at the city park, WDFW boat ramp, and bridge crossing. The access at the city park is an informal trail. No other public access to the shoreline has been identified by the Town of Riverside.<br><br>**Existing Public Access Goals:** No specific goals have been identified by the Town of Riverside or WDFW. The town's only existing property within the shoreline area is at the city park. | |

| **Okanogan River** | **Town of Riverside** |
|---|---|
| **Identified Public Access Improvements:** No specific public access improvement plans have been identified, however, opportunities do exist within the reach. The trail to the river bank and beach area adjacent to the city park could be improved to provide better access for all users. Fencing could also be utilized in this area to protect existing riparian vegetation and to promote the establishment of new growth. The existing WDFW boat ramp could be improved in a number of different ways such as: paving the boat launch, providing additional parking, installing a small floating dock, building new restroom facilities, providing a fish cleaning station, etc., depending on funding and demand. | |

### 3.2.3 Reach 3 Summary

| **Okanogan River** | **Town of Riverside** |
|---|---|
| Reach 3 | Reach Length: 0.5 miles |
| Shoreline Jurisdiction Area in Reach 3: Approximately 13 acres. | |


**Description:** Okanogan River and shorelands within the incorporated Town of Riverside.

**Reach 3, see Figure 12:** Begins at the east boundary of the WDFW boat ramp parcel and extends south approximately 0.8 miles to the south city limit boundary. The majority of the reach is located on the west side of the river, however a small portion is also located on the east side of the river across from the boat ramp.

**Physical Characteristics**

**Ownership:** The reach is owned by three private landowners.

**Existing Land Cover / Development:** The entire reach is comprised of agricultural lands, with the exception of one residential parcel located at the south end of the reach, near the end of Seahawk Drive. Most of the agricultural lands are utilized for livestock grazing. A narrow riparian buffer zone is present along most of the reach between the river and adjacent agricultural and residential areas.

**Land Use / Current SMP**

- Agriculture: Approximately 11.9 acres.
- Residential: Approximately 1.1 acres.

Current SMP environmental designation: Not applicable.

**Major Infrastructure:** Seahawk Drive, a gravel road, crosses the reach near the south boundary.

| **Okanogan River** | **Town of Riverside** |
|---|---|
| **Geomorphic Character:** In Reach 3, the channel is confined and incised within glaciolacustrine (Tonasket silt loam), and glacial outwash (Pogue fine sandy loam) soil deposits.<br><br>**Hardened Banks:** No significant hardened banks were observed during the site visit and aerial photo inspection.<br><br>**Channel Migration Zone Characterization:** Upon inspection of aerial photos and observations made during a site visit, there doesn't appear to be any structures that would limit the river channel's ability to access the adjacent flood plain and wetland areas during high water events. City staff has noted that lands near the boat ramp at the north end of the reach often flood yearly. The river is channelized throughout the reach, and has steep cut banks present at some locations which might limit channel connectivity with flood plains. | |
| **Flooding and Geological Hazards:** The entire reach is located within the 100-year flood plain. As mentioned, lands located at the north end of the reach are subject to yearly flooding despite this designation.<br><br>Two types of soils are present within the reach: Tonasket silt loam and Pogue fine sandy loam. Both soils are rated as having a slight erosion potential when exposed due to various land use activities such as grazing, mining, road construction, and other kinds of disturbance. A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions. The soils have a moderate erosion susceptibility to sheet and rill erosion by water. Both soils have a flood frequency rating of none. The flooding frequency refers to the likelihood of a soil type to periods of temporary inundation caused by overflowing streams and runoff from adjacent slopes. A rating of "none" means that flooding is not probable. Pogue fine sandy loam soils have a drainage class rating of somewhat excessively drained, while Tonasket silt loam is rated as well drained. This likely explains why these soils are generally not subject to periods of temporary inundation – they drain very well. | |
| **Reach Characterization and Analysis** | |
| **Water Quantity and Sediment:** Peak flows in the Okanogan River typically occur during a 2 to 3 week period in May to early June during the spring snowmelt. Lowest stream flows occur in summer and early fall due to nearly absent precipitation and diminishing snowpack. Irrigation practices may subsequently reduce summer flows. In Riverside, irrigation water is diverted from the river to support agriculture during the summer months.<br><br>The river section at Riverside contains a high portion of sand and silts due to input from upstream land uses and disturbances and low river gradient and velocity. Within Reach 3, livestock grazing has resulted in some portions of the riverbank to be largely absent of vegetation which likely causes increased sediment runoff to the river. | |
| **Water Quality:** There is a 303d listing for DDT and PCBs in the Okanogan River. Temperature, pH, turbidity, and fecal coliform water quality problems have also been noted. | |
| **Habitat Characteristics and PHS Species Presence:**<br><br>**Vegetation** - Riparian vegetation has been impacted by livestock grazing in Reach 3. Where a tree canopy is present, black cottonwood and willows dominate. Non-native elm trees are also fairly abundant. Shrubs and grasses includes spirea, rose, and reed canary grass (*Phalaris arundicacea*). This reach has limited tree cover and sources for large woody debris (LWD) recruitment. | |

| **Okanogan River** | **Town of Riverside** |
|---|---|
| Riparian zone vegetation generally varies between 20 and 70 feet wide. Vegetation adjacent to the riparian zone is comprised mainly of small grasses and shrubs. Most shrub steppe vegetation is absent, although sagebrush, rabbitbrush, and native grasses occur in some locations. Noxious weed species might also exist, especially in disturbed areas.<br><br>**Wetlands** - A freshwater pond wetland with an area of approximately 3 acres is found within the 100-year flood plain of the reach. This pond appears to have standing water only during wetter periods of the year.<br><br>**Wildlife** - There are regular concentrations of mule deer in the area. The reach provides breeding habitat for Golden eagles, Bald eagles, Columbia Sharp-tailed Grouse, and cavity-nesting ducks. The river supports migratory habitat for native anadromous fish species including Steelhead, Chinook salmon, and Sockeye salmon, and also for native resident species including Rainbow trout and Pygmy whitefish. The river in the vicinity of Riverside is an important Summer Chinook breeding area. Non-native fish species such as smallmouth bass and carp may also occur. | |
| **Ecological Functions Analysis – Reach 3** | |
| **Level of Existing Function:** Functioning<br><br>**Stressors:** Livestock impacts on riparian and shrubsteppe vegetation. The river bank has been trampled and denuded of vegetation at a livestock access point to the river.<br><br>**Potential Stressors:** Further riparian vegetation removal, expansion of non-native invasive weed species.<br><br>**Potential Restoration Opportunities:** Work with private landowners to voluntarily restore native riparian vegetation needed to filter sediments and contaminants from agricultural fields and to provide large woody debris (LWD) recruitment. Utilize bioengineering techniques in combination with live vegetation to stabilize stream banks and reduce sedimentation. Work with local land managers and conservation groups to conduct vegetation surveys to identify the extent of invasive weed species so that a plan can be implemented to control their spread.<br><br>**Potential Protection Opportunities:** Install fencing to limit livestock grazing to areas outside of the riparian zone and wetlands, and to consolidate water access areas for livestock. | |
| **Preliminary Shoreline Environment Designation Considerations:** Apply designation(s) that allow for continuation of existing agricultural and maintain/protect existing riparian zone and wetland areas. An environmental designation of Rural-conservancy may be appropriate for Reach 3. | |
| **Public Access** | |
| **Existing Public Access:** There are no existing public access locations within Reach 3. | |
| **Existing Public Access Goals:** No specific goals have been identified by the Town of Riverside for Reach 3. | |
| **Identified Public Access Improvements:** No specific public access plans have been identified in the reach, and there are limited opportunities for future improvements. The land is privately owned, with no public access. | |

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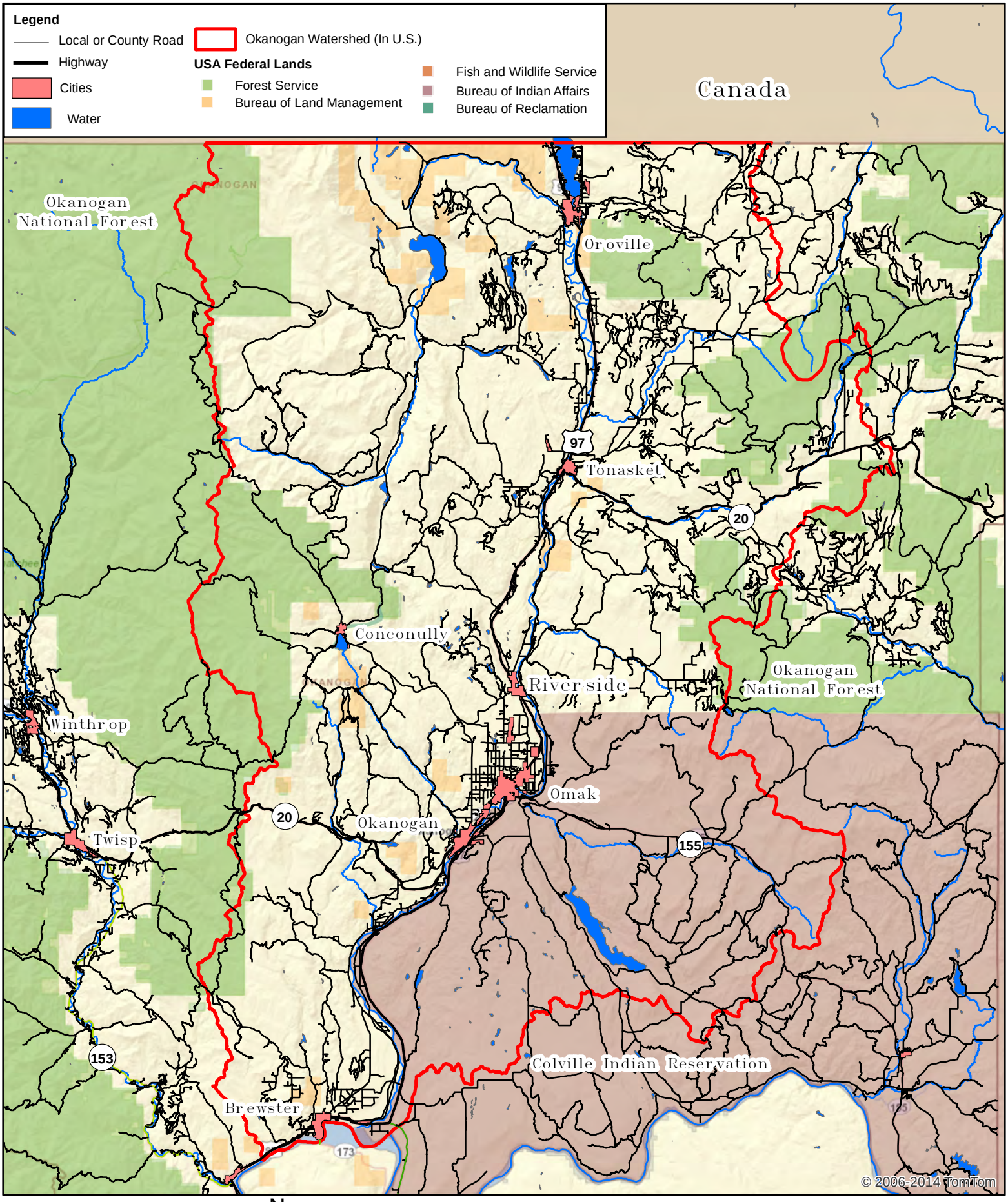
# Figures: Map Portfolio

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| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 1: Regional Context |
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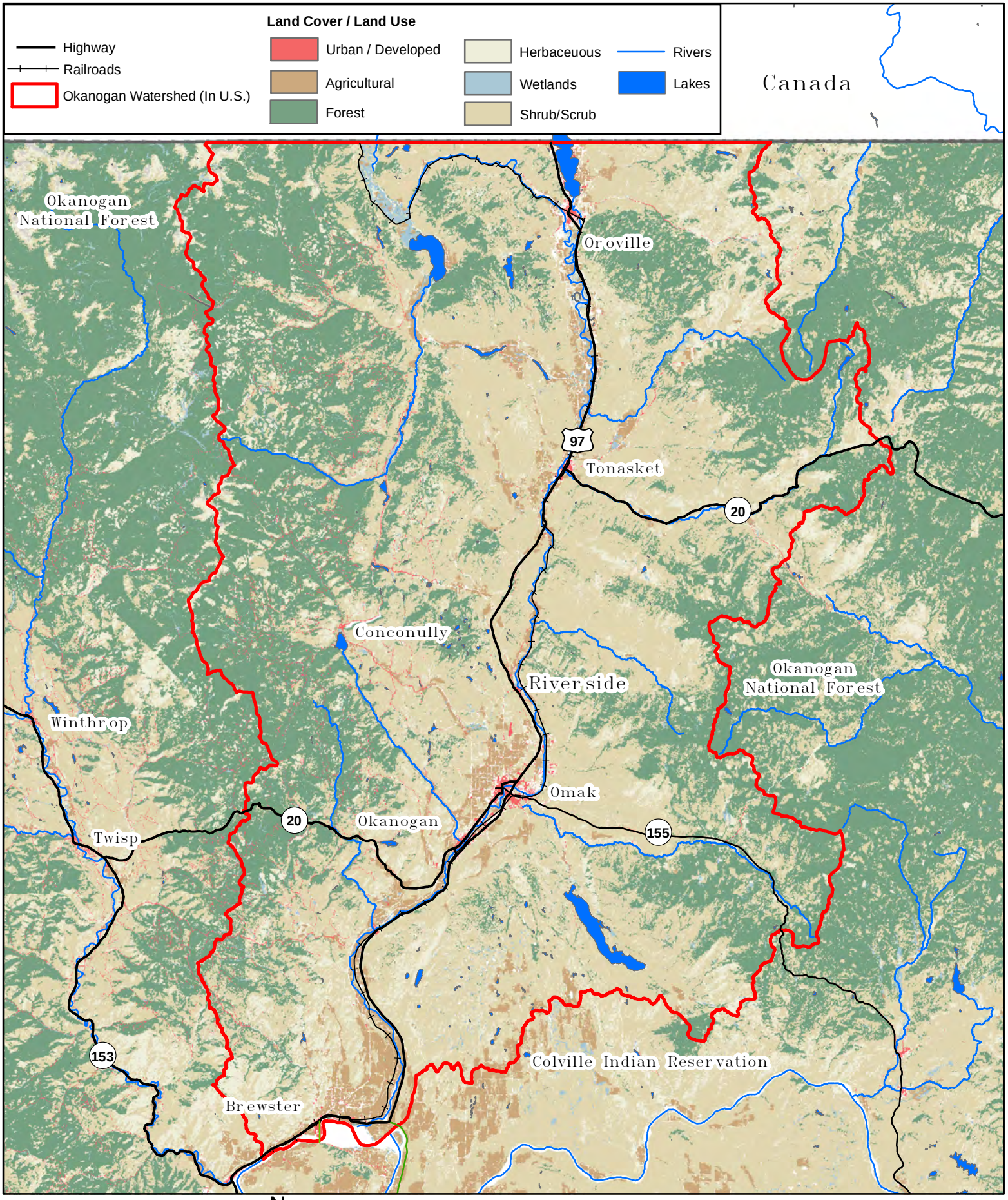
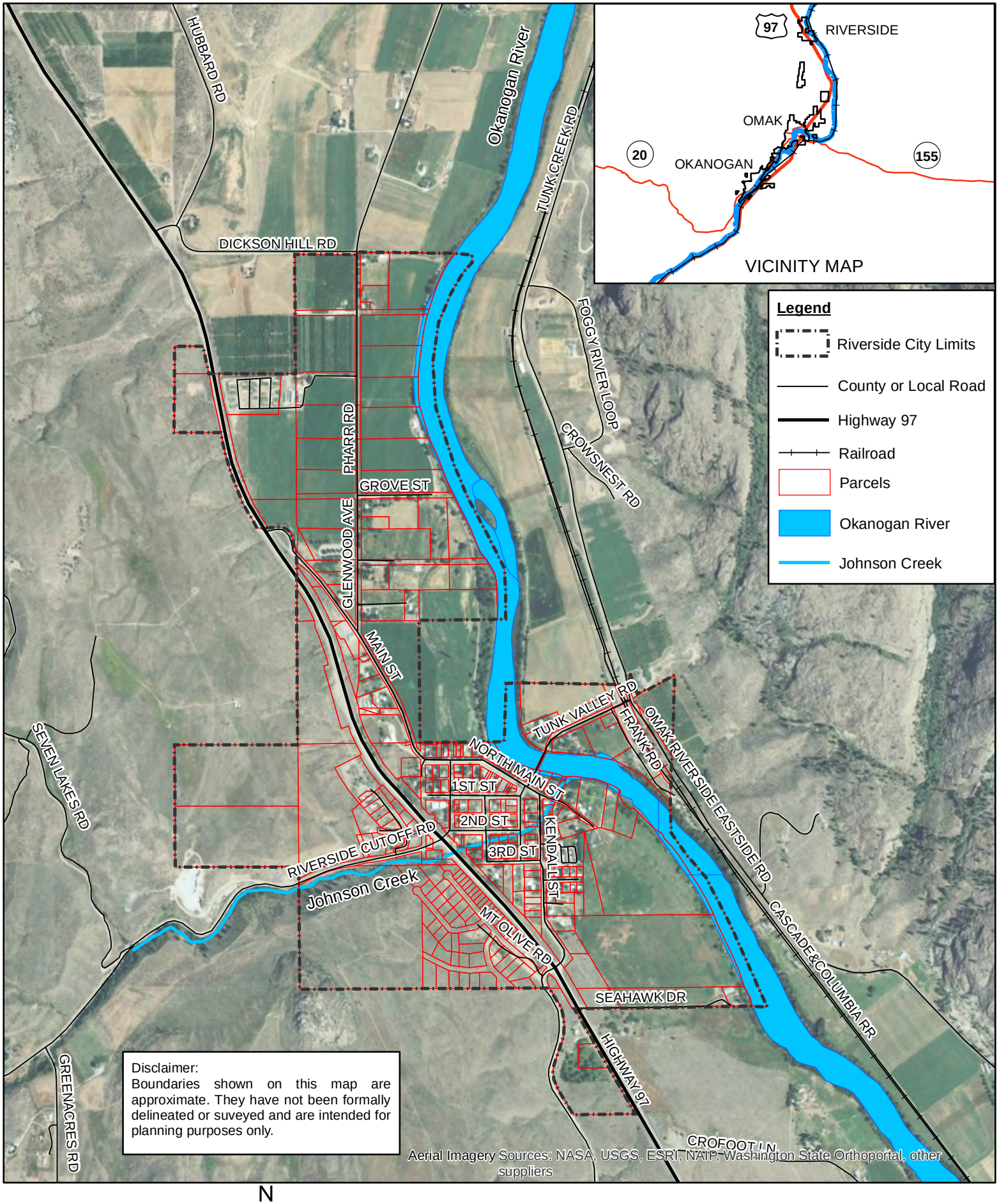



| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 2: Regional Land Uses and Land Cover |
|---|---|---|




| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 3: TOWN OF RIVERSIDE MAP |
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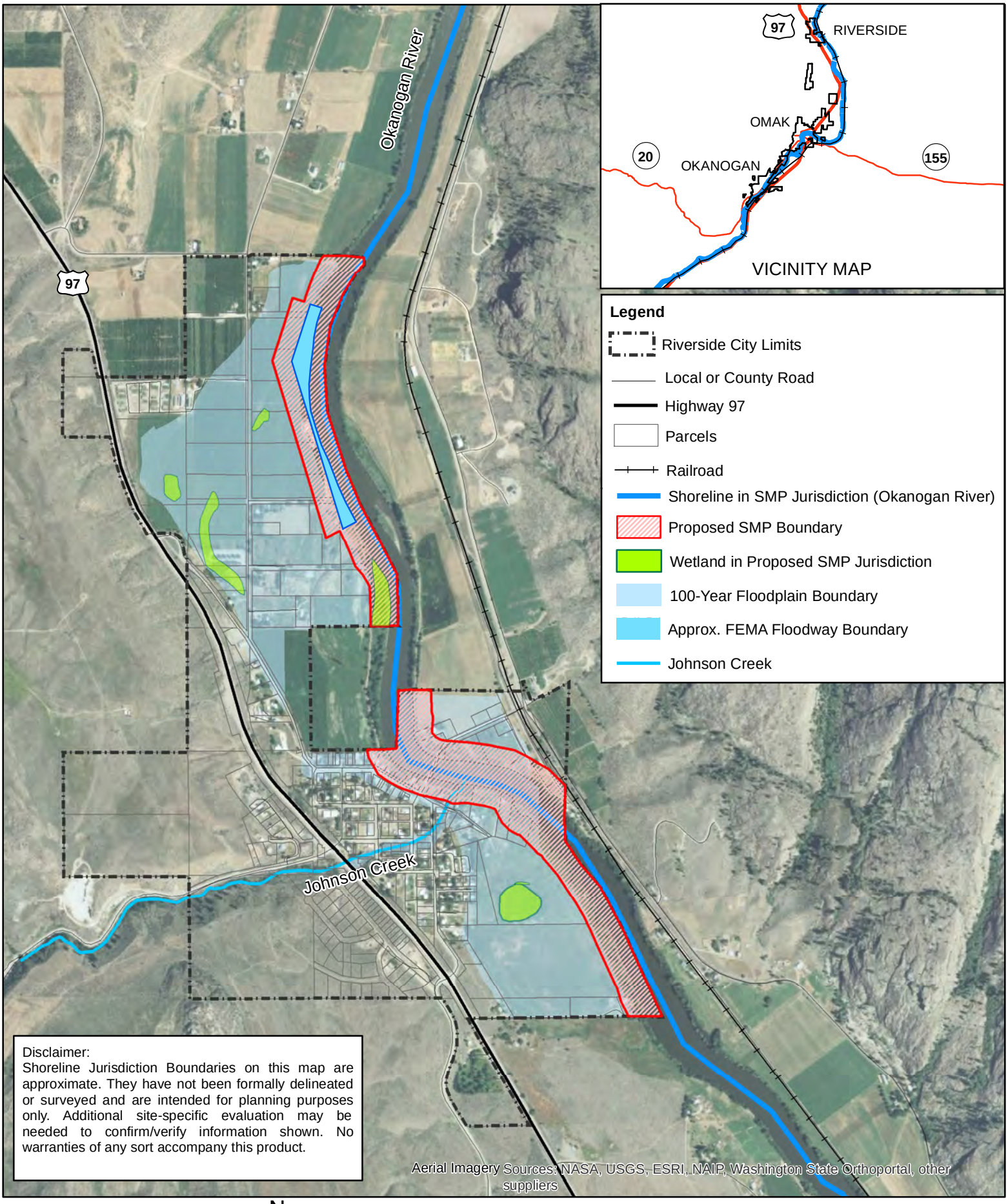


| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 4: Shoreline Jurisdiction |
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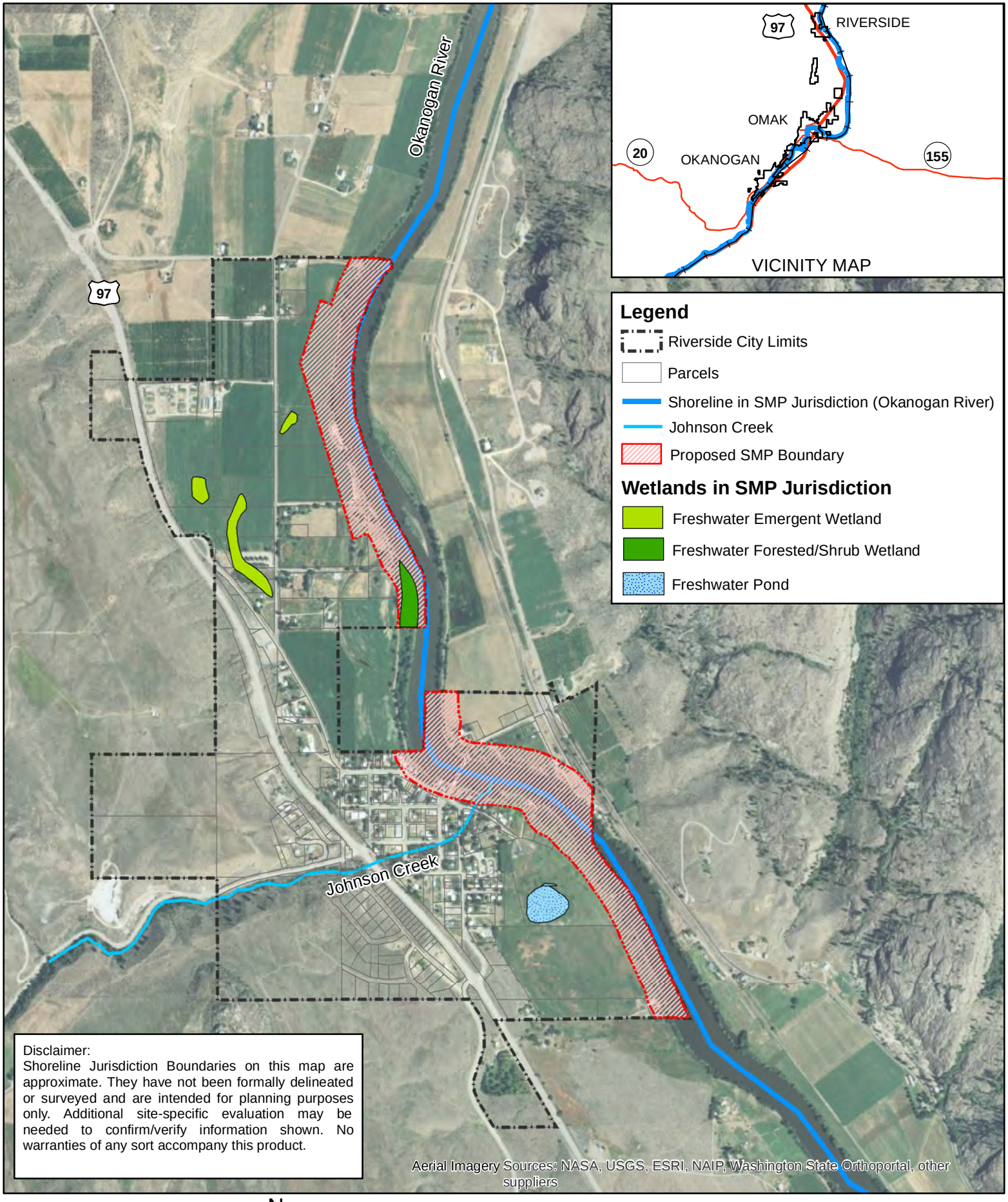


| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 5: Wetland Locations |
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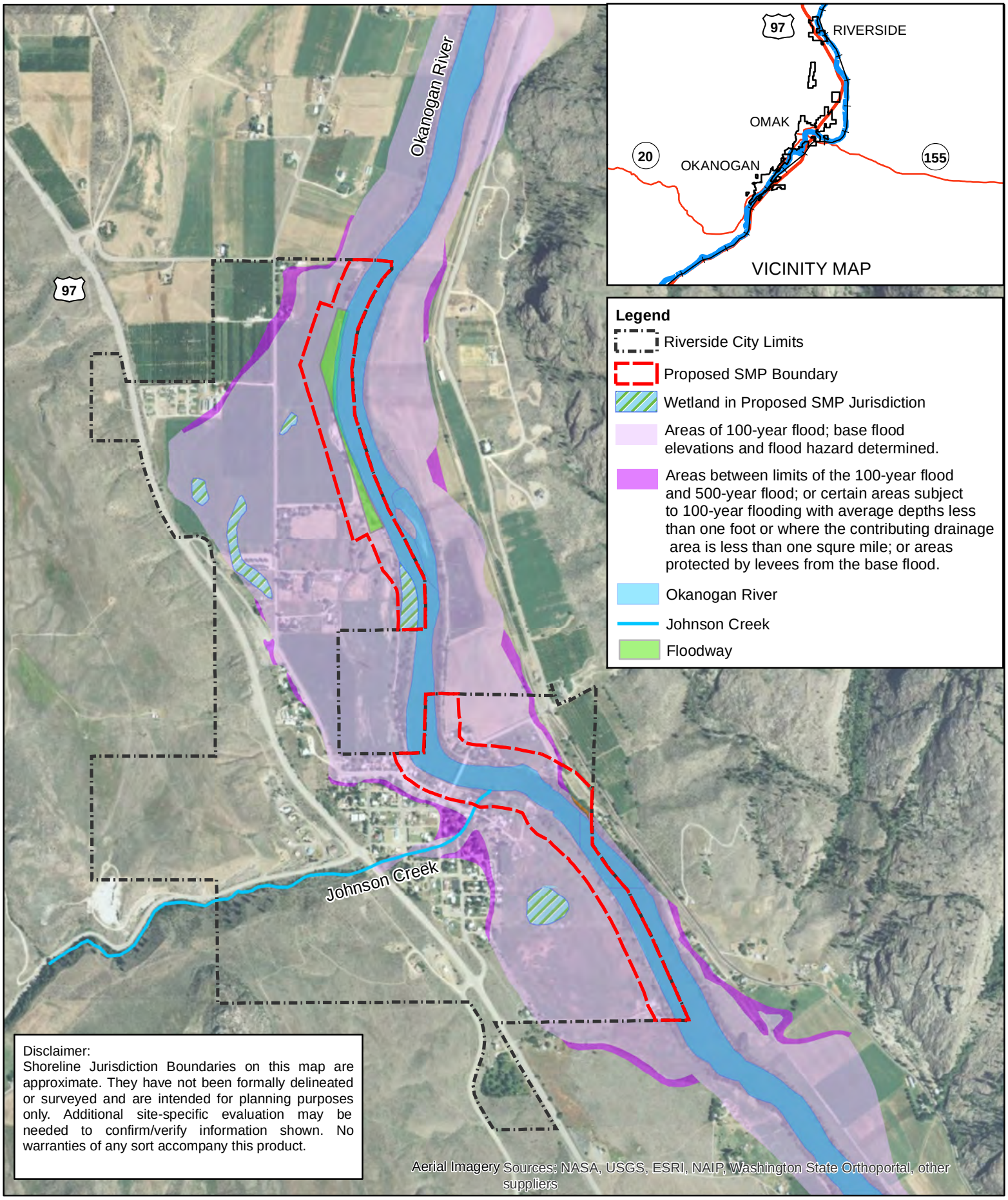


| Town of Riverside SMP | FORSGREN Associates Inc. | **FIGURE 6: Floodway and Flood Hazard Zones** |
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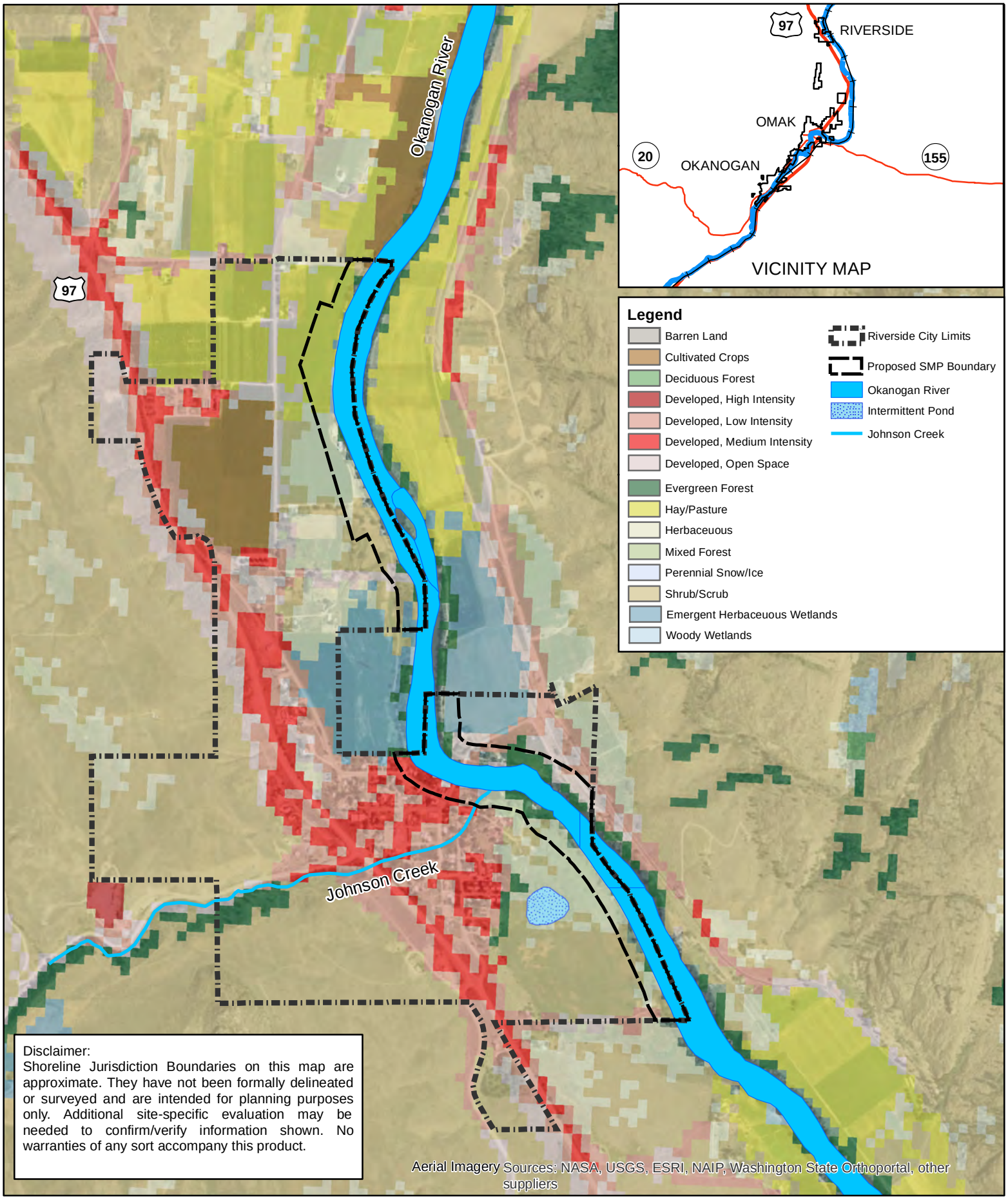


| Town of Riverside SMP | FORSGREN Associates Inc | FIGURE 7: Existing Land Cover |
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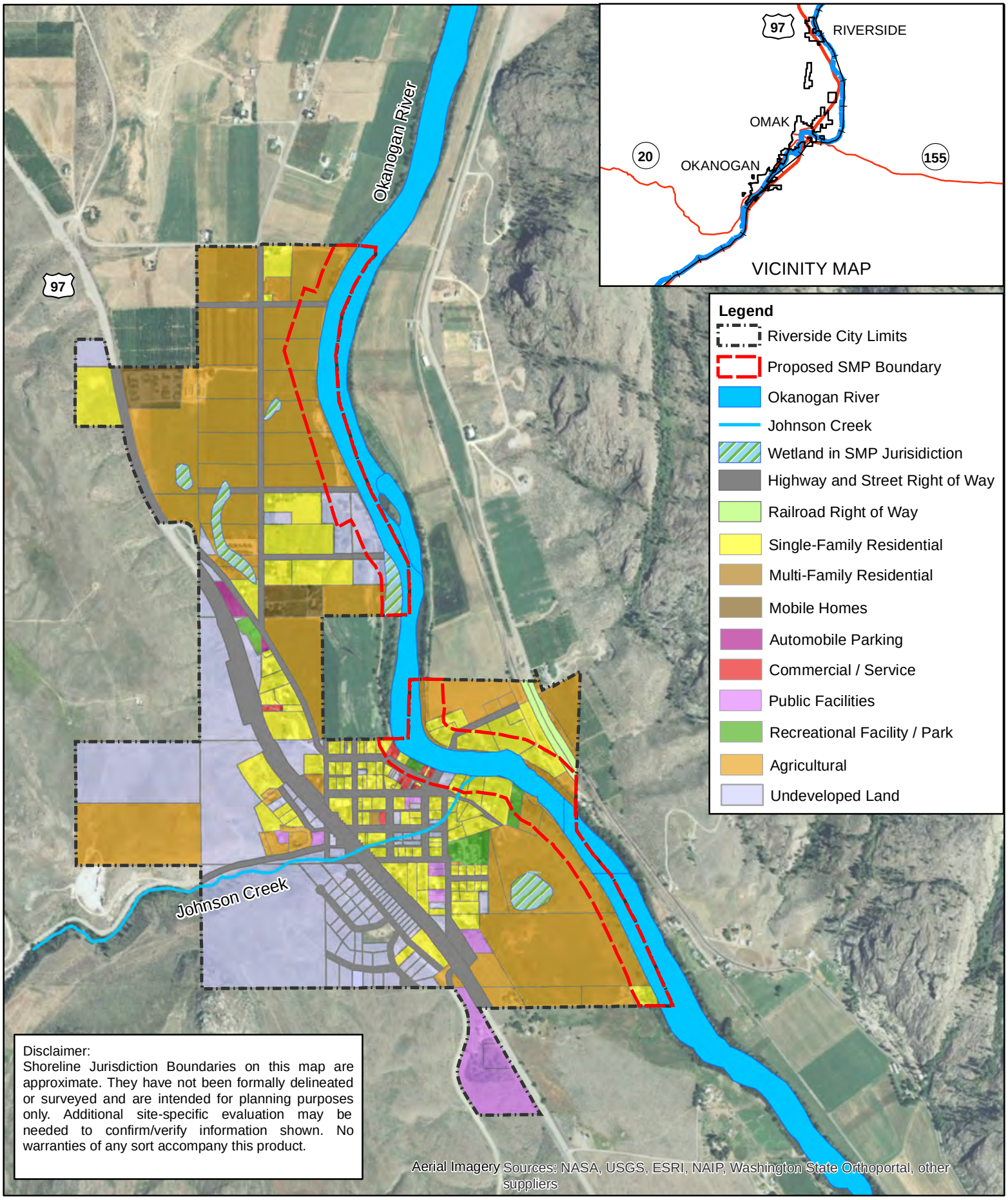


| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 8: Existing Land Use |
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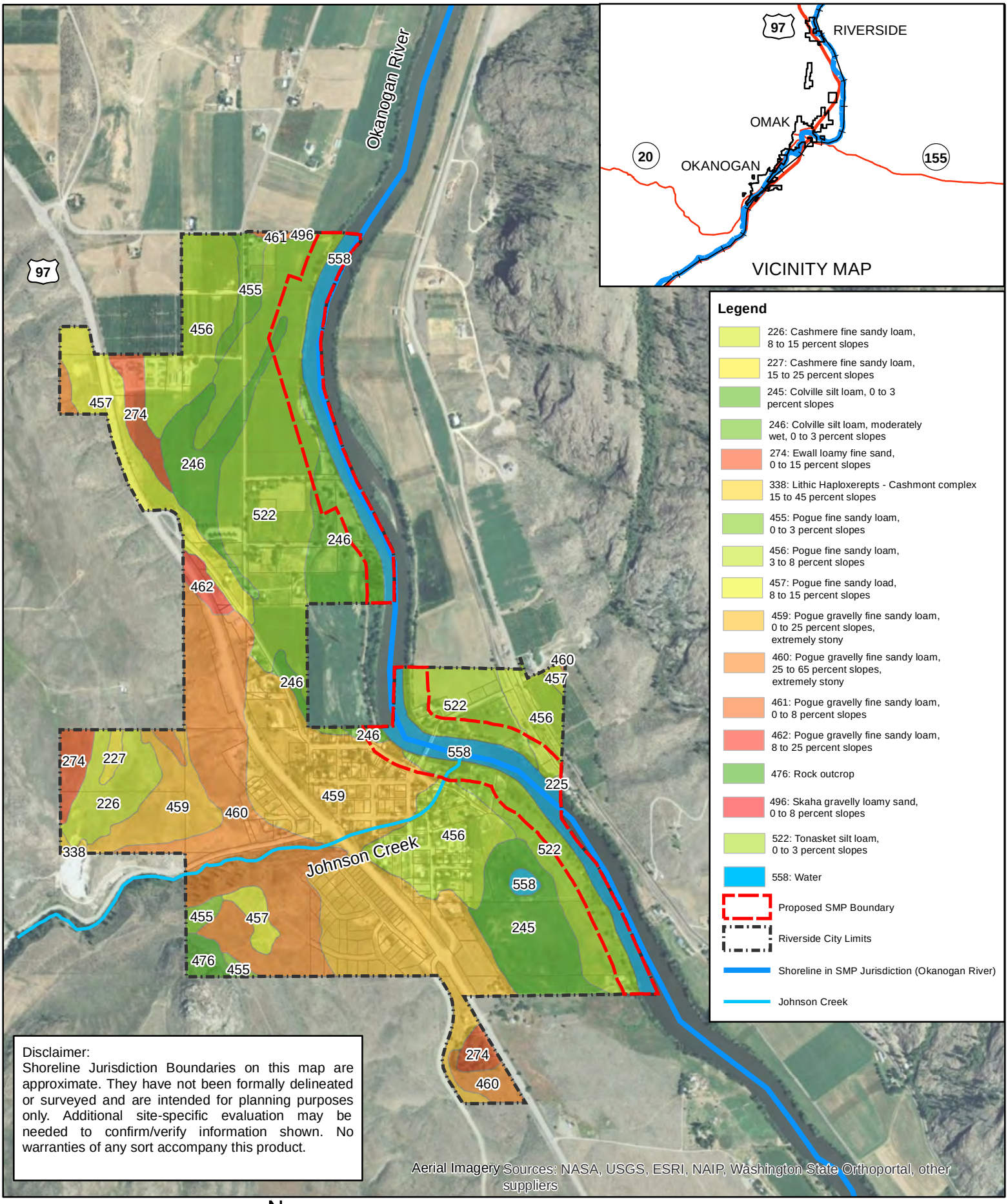


| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 9: Soil Type |
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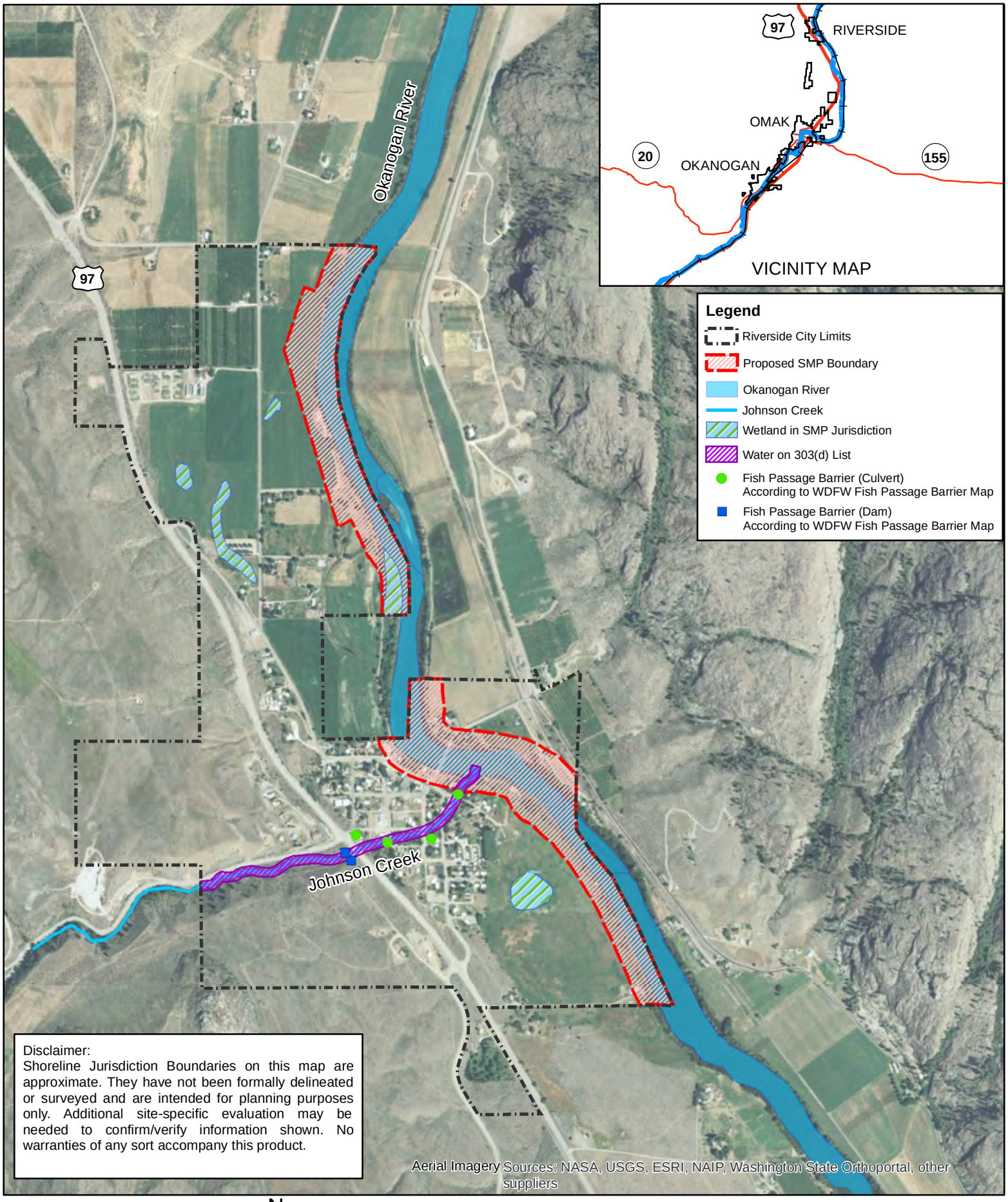


| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 10: Fish Passage Barrier & 303(d) Water |
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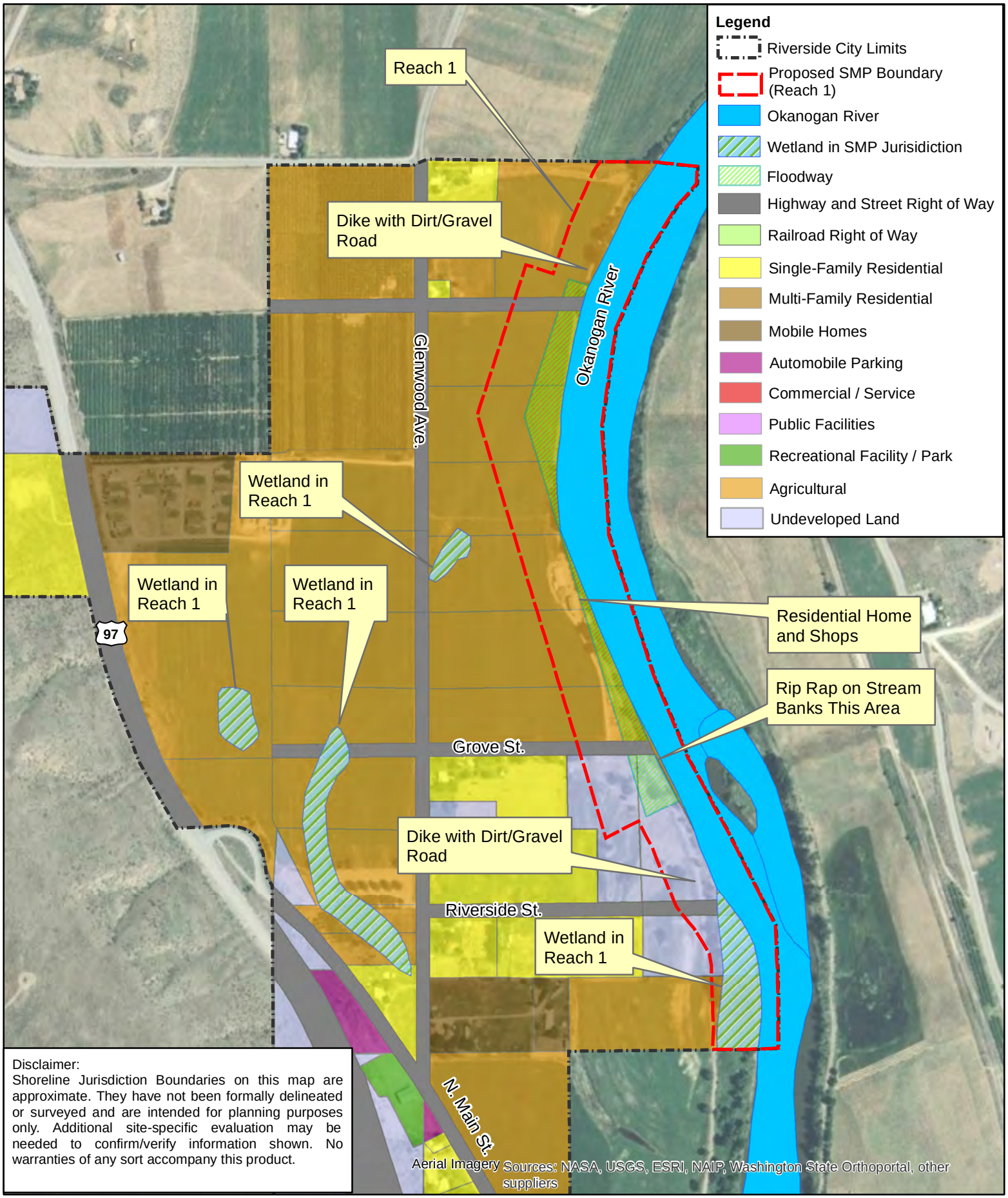


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Shoreline Jurisdiction Boundaries on this map are approximate. They have not been formally delineated or surveyed and are intended for planning purposes only. Additional site-specific evaluation may be needed to confirm/verify information shown. No warranties of any sort accompany this product.

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| Town of Riverside SMP | FORSGREN Associates Inc. | FIGURE 11: Reach 1 |
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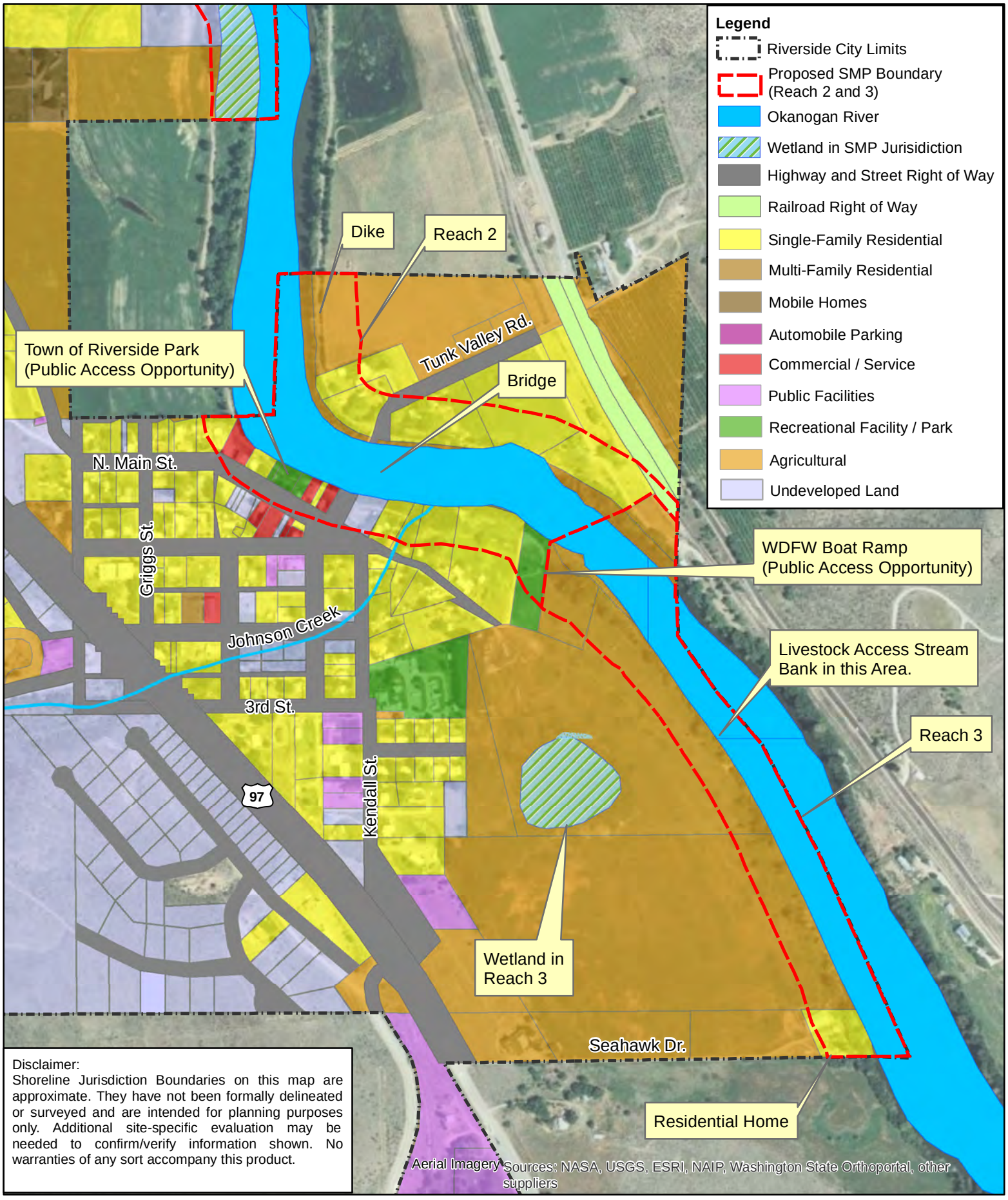


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Shoreline Jurisdiction Boundaries on this map are approximate. They have not been formally delineated or surveyed and are intended for planning purposes only. Additional site-specific evaluation may be needed to confirm/verify information shown. No warranties of any sort accompany this product.

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| Town of Riverside SMP | FORSGREN Associates Inc. | **FIGURE 12: Reach 2 and 3** |
|---|---|---|