The Middle Deschutes
Pesticide Stewardship Partnership
Strategic Plan

The Middle Deschutes
Pesticide Stewardship Partnership
Strategic Plan

Prepared By:

Jefferson County Soil and Water Conservation District

And the

Middle Deschutes Pesticide Stewardship Partnership Advisory Council

With guiding support from the

Oregon Department of Agriculture

Oregon Department of Environmental Quality

Oregon State University

July 2023

Acknowledgements

We wish to thank the many allies who helped develop this plan. Our Advisory Council was a valued group of people who genuinely understood the importance of this cause and wanted to take part in a better future for the Middle Deschutes community. It was through their support, insight, and vision that this plan became possible.

Table of Contents

Acronyms

ALB- Aquatic Life Benchmark
ALR- Aquatic Life Ratio
BIA-Bureau of Indian Affairs
BPA- Bonneville Power Administration
CIS- Conservation Implementation Strategy
CRP- Conservation Reserve Program
CTWS- Confederated Tribes of Warm Springs
DEQ- Oregon Department of Environmental Quality
DBBC- Deschutes Basin Board of Control
EQIP- Environmental Quality Incentives Program
ESA- Endangered Species Act
HCP-Deschutes Basin Habitat Conservation Plan
LPP-Local Problem Pesticide
MDPSP- Middle Deschutes Pesticide Stewardship Partnership
MDWC- Middle Deschutes Watershed Council
NRCS- National Resource Conservation Service
NTU- Nephelometric Turbidity Unit
NUID- North Unit Irrigation District
ODA- Oregon Department of Agricultural
ODFW- Oregon Department of Fish and Wildlife
ODF- Oregon Department of Forestry
OHA-Oregon Health Authority
OSU-Oregon State University
OSF-Oregon spotted frog
OSP-Oregon State Parks
OWEB- Oregon Watershed Enhancement Board
PGE- Portland General Electric
POC- Pesticide of Concern
POI- Pesticide of Interest
PSP- Pesticide Stewardship Partnership
SIA- Strategic Implementation Area
SWCD- Jefferson County Soil and Water Conservation District
TMDL- Total Maximum Daily Load
TU- Trout Unlimited
USFS- United States Forest Service
WQPMT-Water Quality Pesticide Management Team

Plan Content

Section 1: Pesticide Stewardship Partnership Program Purpose and Background. Presents consistent and accurate information about the Oregon Pesticide Stewardship Partnership Program.

Section 2: Local Background. Provides the local history, geography, hydrology, water quality, and agricultural context for the Management Area.

Section 3: Implementation Strategies. Presents goals, measurable objectives, strategic initiatives, proposed activities, and monitoring.

Section 4: Progress and Adaptive Management. Describes progress toward achieving the goal of the Strategic Plan.

Section 1. Pesticide Stewardship Partnership Program

The Oregon Pesticide Stewardship Partnership (PSP) program has been active for nearly two decades before coming to the Middle Deschutes Watershed. Though primarily focused on watersheds with heavy agricultural use, the diversity of watersheds served range in land use, geology, pesticide* use, and climate. The success of this program resides in its focus on voluntary, locally-led initiatives to reduce pesticides in the surrounding waters. By fostering this voluntary effort, the community can develop solutions customized to their local situation without the fear and stress of regulation. The proactive approach negates the need for regulatory intervention and has proven to be an effective method to change behaviors on a regional scale.

As of 2022, there are nine partnerships, representing nine different rivers, watersheds, and partnership groups. The Middle Deschutes Pesticide Stewardship Partnership (MDPSP) began its partnership in 2019 which kickstarted the development of a sampling scheme and the MDPSP Strategic Plan. The MDPSP first started as a pilot in 2017 before becoming an official partnership in 2019. This voluntary effort has gained momentum through the development of this Strategic Plan. This Strategic Plan was development in collaboration with landowners, local businesses, municipalities, local partners, and technical support staff.

*Pesticide inclusively refers to pesticides, herbicides, insecticides, and fungicides.

1.1 Oregon Pesticide Stewardship Partnership Program

First established in 2000, the partnership of collaborating agencies has worked closely across many watersheds of Oregon to identify potential concerns and improve water quality affected by pesticide use through voluntarily PSPs (Oregon Department of Agriculture, 2023). The Oregon PSP program is co-led by Oregon Department of Agriculture (ODA) and Department of Environmental Quality (DEQ) but supported by the Water Quality Pesticide Management Team (WQPMT). This team is composed of representatives from multiple state agencies to efficiently address the protection of waters of the state from pesticide contamination. The WQPMT advises the development and final approval of efforts such as the Strategic Plan to ensure its quality. The WQPMT consists of representatives from the following agencies and academic institution:

- Oregon Department of Agriculture
- Department of Environmental Quality
- Oregon Department of Fish and Wildlife
- Oregon Department of Forestry
- Oregon State University
- Oregon Health Authority

1.2 Middle Deschutes Pesticide Stewardship Partnership

The MDPSP was first formed in 2017 in partnership with the Jefferson County Soil and Water Conservation District (SWCD), the Middle Deschutes Watershed Council (MDWC), ODA, and DEQ. It began as a pilot study which monitored the pesticide concentration within Willow

Creek, Campbell Creek, and Mud Springs Creek drainages to the Middle Deschutes River. In 2019, the results of the pilot informed the development of the MDPSP and its initial sampling scheme which exchanged monitoring the Willow Creek drainage for the Culver Drain. In 2021, the program sought to not only continue the sampling designed in 2019, but to reflect on results to construct the Middle Deschutes PSP Strategy Plan (the Strategic Plan). The construction of the Strategic Plan established water quality and communication goals and strategies that fit the Middle Deschutes community and the challenges faced therein. The process of developing the Strategic Plan led to the redistribution of sampling efforts in order to track water quality across more drainages. Frog Springs and Rattlesnake Canyon drainages were added to the list of drainages monitored.

1.3 Roles and Responsibilities

The Oregon PSP is a program funded and overseen by ODA and DEQ but implemented locally by the soil and water conservation district or watershed council. The MDPSP is managed and implemented by the SWCD who calls upon an advisory council of local partners for plan development and direction. The SWCD performs the monitoring and sends samples to the DEQ lab for analysis. DEQ provides the sample bottles, sample analysis, and results to the MDPSP. ODA consults with the SWCD on community outreach and project implementation to ensure improved water quality with time and effort. The SWCD leads outreach, data sharing, reporting, local collaboration, and plan implementation.

1.4 Middle Deschutes Management Area

For congruency with regional water quality plans and initiatives, the MDPSP aligns its Management Area with the ODA's Middle Deschutes Agricultural Water Quality Management Area (Oregon Department of Agriculture, 2020). This boundary modifies the Middle Deschutes-Shitike Creek Watershed boundary (HUC-8) to align with regions managed with an increased risk of impacting water quality. The two modifications to the HUC-8 boundaries which create the Management Area include expanding the southwest border to include the Culver Area (bound by the Crooked River and Lake Billy Chinook), and to exclude the Shitike Creek drainage west of the Deschutes River. By modifying the boundaries in this way, it focuses effort on the irrigated agricultural predominantly served by North Unit Irrigation District (NUID) and its surrounding uplands (Figure 1).

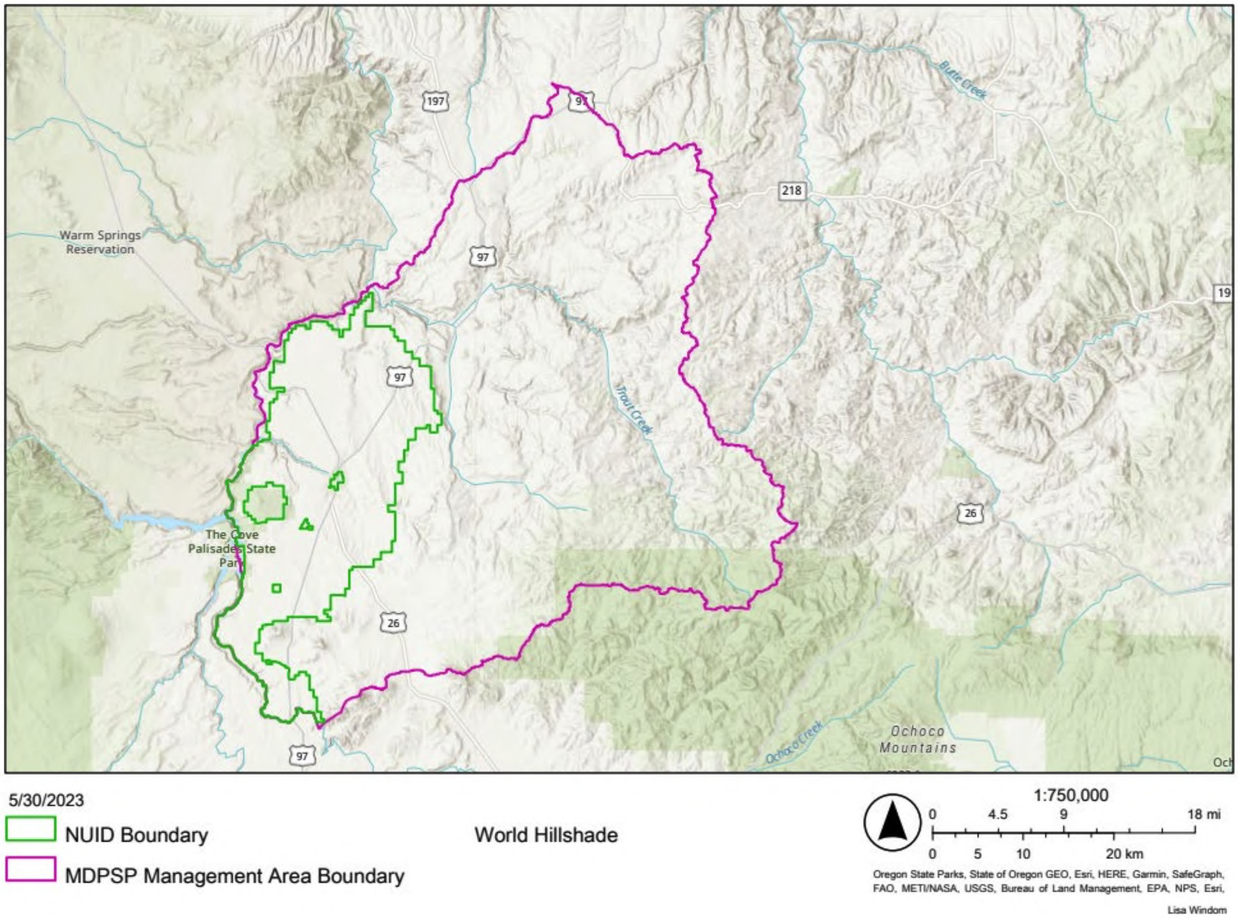

Figure 1. Middle Deschutes Pesticide Stewardship Partnership Management Area and NUID Service Boundary

Section 2. Local Background

The history of land development, hydrology of the watershed, and geology of the landscape play pivotal roles in understanding why and where pesticide transport may be a source of concern. American settlers reached this western region two centuries ago to establish homesteads, railroads, and cities. Today, the landscape remains open and rural with farm fields, with towering volcanos among the Cascade Range to the west, and conifer-covered buttes from the Ochoco Mountains to the east. The Deschutes River cuts through the middle, providing water for the farms and a path of passage for the railroad out to the Columbia River. With a long history of volcanic flows and debris covering the region, the topsoil is shallow atop basaltic cliffs and plateaus. The region is arid and covered with sage brush, grassland, and upland coniferous forests.

2.1 History of the Land

Prior to American settlers, the land was occupied by native tribes whose culture was entwined with the natural resources of their home. In 1855, the Treaty with the Tribes of Middle Oregon, a treaty between the United States and the Warm Springs and Wasco tribes, ceded 10 million acres of aboriginal lands to the United States and defined the boundaries of the Warm Springs

Reservation (Confederated Tribes of Warm Springs, 2021). The ceded lands included much of the John Day and Deschutes watersheds in present day Central Oregon. American settles began homesteading the land to the east of the Middle Deschutes River through dryland farming.

The influx of people coincided with the Reclamation Act of 1902 which pushed to settle the west by developing irrigation projects to serve family farms and to stabilize settlement in the arid west (North Unit Irrigation District, 2019). By 1949, North Unit Irrigation District (NUID) established an irrigation network through 58,880 acres of cultivated land surrounding the cities of Culver, Metolius, Madras and Gateway.

In 1964, the Pelton Round Butte project installed three dams downstream of the confluence of the Metolius River, the Crooked River and the Deschutes River (Portland General Electric, 2020). This project was a collaboration between Portland General Electric (PGE) and the Confederated Tribes of Warm Springs (CTWS) to create emission-free hydropower. The dams created Lake Billy Chinook, Lake Simtustus, and the reregulating reservoir. PGE and CTWS integrate water quality and safe fish passage with their dam management, modernization, and ongoing research.

2.2 Watershed Description

Located in Central Oregon, the Deschutes River is a south to north flowing river which receives runoff from the Cascade and Ochoco Mountains before heading north to converge with the Columbia River. The Deschutes River is subdivided into the Upper, Middle, and Lower regions which loosely align with the county lines of the three counties it passes: Deschutes, Jefferson, and Wasco, respectively. The Middle Deschutes River runs from the Jefferson County border to the confluence of the Warm Springs River (Figure 2). The Metolius, Deschutes, and Crooked Rivers each combine at Lake Billy Chinook to form the progression of the Deschutes River downstream. Lake Billy Chinook is contained by the Round Butte Dam, which discharges into Lake Simtustus, then to the Reregulating Reservoir. Lake Simtustus is bound by the Pelton Dam, followed by the reregulating reservoir and reregulation dam. Though this reach is commonly referred to by the reservoirs, it is the flow path of the Middle Deschutes River which flow in and out of these reservoirs.

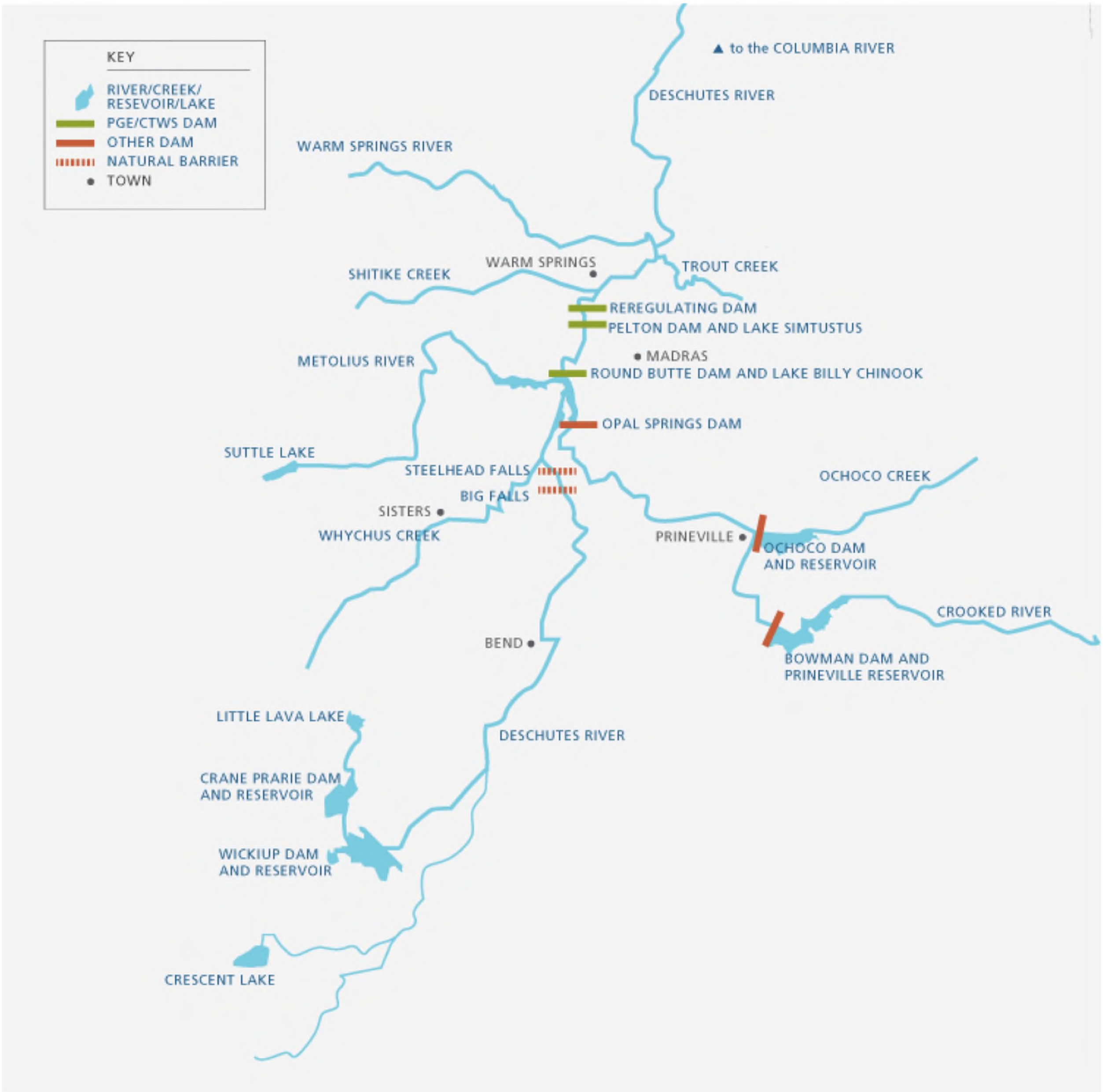

Figure 2. Reservoirs and Dams of the Deschutes Basin, figure credit to the Pelton Round Butte Project.

The Middle Deschutes River receives drainage from multiple tributaries which provides a mixture of agricultural run-off, precipitation (as rain and snow), and spring discharge. The MDPSP monitors watersheds that drain from the irrigated agriculture around the cities of Culver, Madras and Gateway into the Middle Deschutes River (via Lake Billy Chinook, Lake Simtustus, and Trout Creek).

2.2.1 The Middle Deschutes River

As a Wild and Scenic River, the Middle Deschutes River provides many values to the community, including cultural, ecological, recreational, and scenic beauty. It also provides habitat for fish and wildlife both within and along its banks, including habitat and passage to the threatened Middle Columbia steelhead. Each spring and winter the anadromous fish seek passage to sensitive breeding habitat within its tributaries which is one of many motivations behind establishing the MDPSP. Alongside the Middle Columbia steelhead are spring chinook, fall chinook, bull trout, redband trout, and sockeye salmon; these are all popular to anglers and have put this stretch of river on the global map for recreational fishing. Ongoing efforts to support fish passage over the Pelton Dams and into the headwaters of important tributaries such as Trout Creek continue to restore the migratory reaches of these fish impacted by channel obstruction and over-fishing.

2.2.2 Lake Billy Chinook

Iconic in its beauty, Lake Billy Chinook is flanked by 200-700 ft canyon walls, formed from 11 million years of these three rivers carving into the Deschutes Formation (Figure 3). The canyon walls include alternating layers of basaltic lava, stream sediment, and volcanic debris flow into the area from the Cascade Range. Atop the canyon is a layer of "rimrock basalt" from the Newberry Volcano one to two million years ago. From Lake Billy Chinook dam downstream, the canyon widens to open valleys, plateaus and rolling landscape. The valleys are still capped by the red "rimrock basalt" but the canyons have widened into valleys established with grasslands. Tributaries converge from the surrounding canyons, foothills, and mountains. This stretch of the river (from the Pelton Reregulating Dam to the Confluence of the Columbia River) is so beautiful and valued, it is a National Wild and Scenic River.

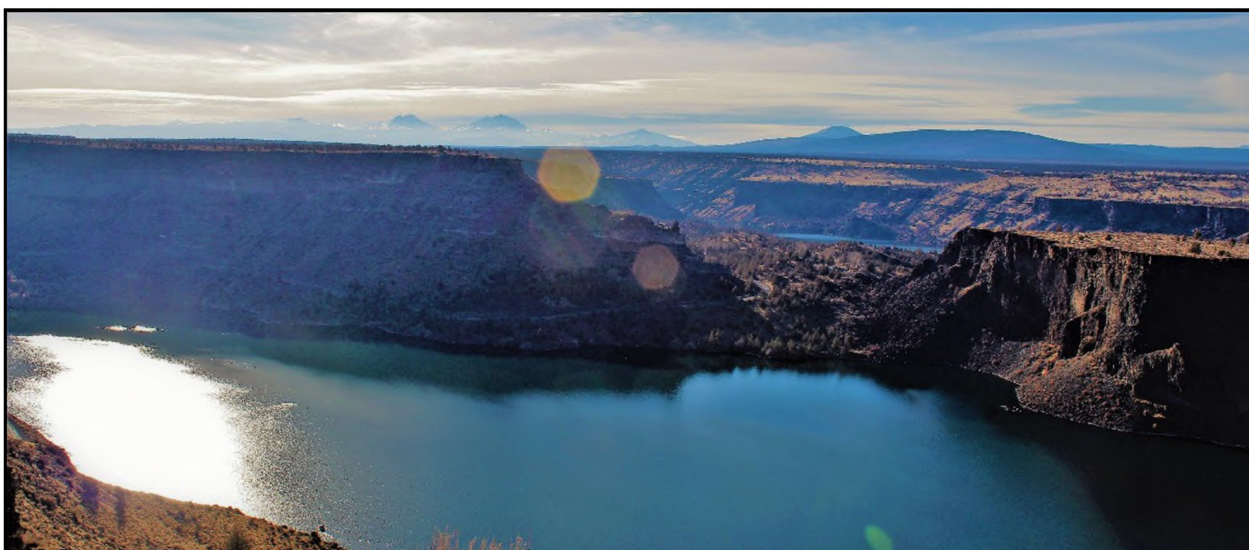

Figure 3. Lake Billy Chinook with Three Sisters on the horizon. Photo Credit Lisa Windom.

2.2.3 Monitored Tributaries

The Middle Deschutes River receives drainage from the south, east and west via multiple sub-watersheds, but the Management Area of this Plan only focuses on those draining from the east. The sub-watersheds monitored in this plan include Campbell Creek, Mud Springs Creek, the Culver Drain, Frog Springs Creek, and Rattlesnake Canyon (Figure 4). Each sub-watershed has unique characteristics to its geology, flow path, landscape, and hydrology, but they all share similar land uses and management. Campbell Creek (as shown in Figure 5), Mud Springs Creek, and the Culver Drain have been monitored since the MDPSP Pilot in 2017; Rattlesnake Canyon and Frog Springs will be added with this implementation of the Strategic Plan to widen the scope of monitoring efforts.

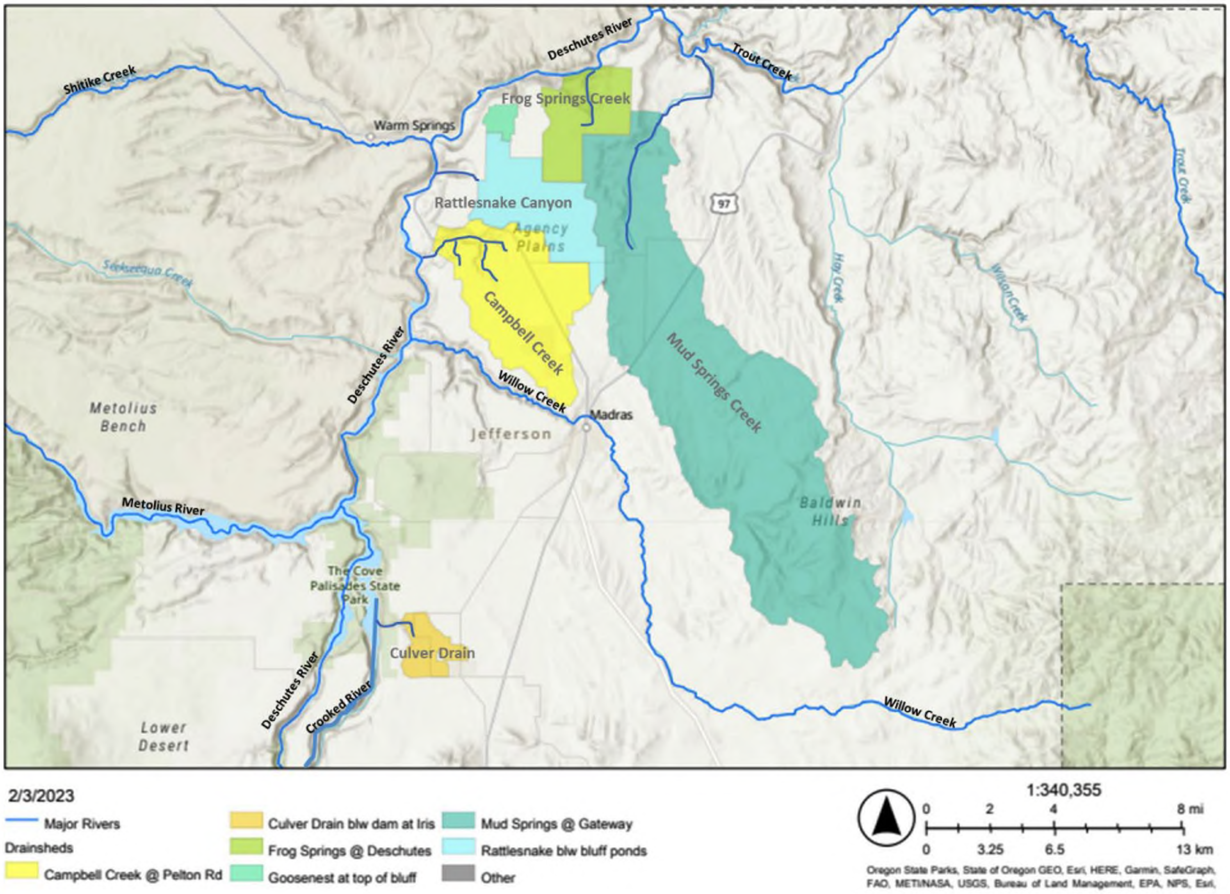

Figure 4. Major Rivers and Monitored Sub-Watershed of the Middle Deschutes River

Figure 5. Campbell Creek Sub-Watershed, looking upstream. Photo credit to Ally Steinmetz.

Campbell Creek, Frog Springs, and Rattlesnake Canyon drain from a plateau referred to as Agency Plains. Agency Plains is a volcanic plateau with shallow topsoil that has been cultivated for nearly a century, with the aid of irrigation. These sub-watersheds drain from the volcanic plateau over the rimrock, through a natural canyon to the Middle Deschutes River. The three drainages receive surface runoff from the plateau, and groundwater contributions from springs throughout each canyon.

The Culver Drain receives drainage from the City of Culver and the region surrounding Juniper Butte. The Culver area is within a valley among towering buttes. The valley has deep, loamy topsoil and rolling hills which guide drainage towards the volcanic rim of Lake Billy Chinook. Like a crack in the earth, the rolling hills drop off into the vertical, volcanic canyon with walls showing the millions of years of volcanic activity of the area.

Similar to the Culver area, Mud Springs Creek drains a hilled valley with deeper topsoil than Agency Plains. As the largest sub-watershed monitored by the MDPSP, the Mud Springs Creek watershed drains rolling, cultivated fields before entering a sandy, volcanic canyon to Trout Creek. From Gateway, the railroad follows Mud Springs Creek to Trout Creek, then to the Deschutes River before it follows it north to the Columbia River.

2.2.4 Irrigation Network and On-Farm Irrigation

The NUID distribution system provides continuous water flow to the region from April through October. It includes 300 miles of open and piped canals that are completely gravity-fed (Figure 6). A majority of the canal network is open, earthen canals which involve regular vegetation management and noxious weed treatment. Growers often require a booster pump at their point of delivery to run sprinkler lines, pivots, and drip lines, but furrow irrigation applies gravity to irrigate the fields. When first established in 1947, the fields were furrow irrigated by a complex gravity-fed system among the fields (North Unit Irrigation District, 2019). Water would flow from field to field through a drainage network, which still serves as a means to share water among neighbors today. Water efficiency is paramount for the growers in this region; every drop of water is used and reused a much as possible.

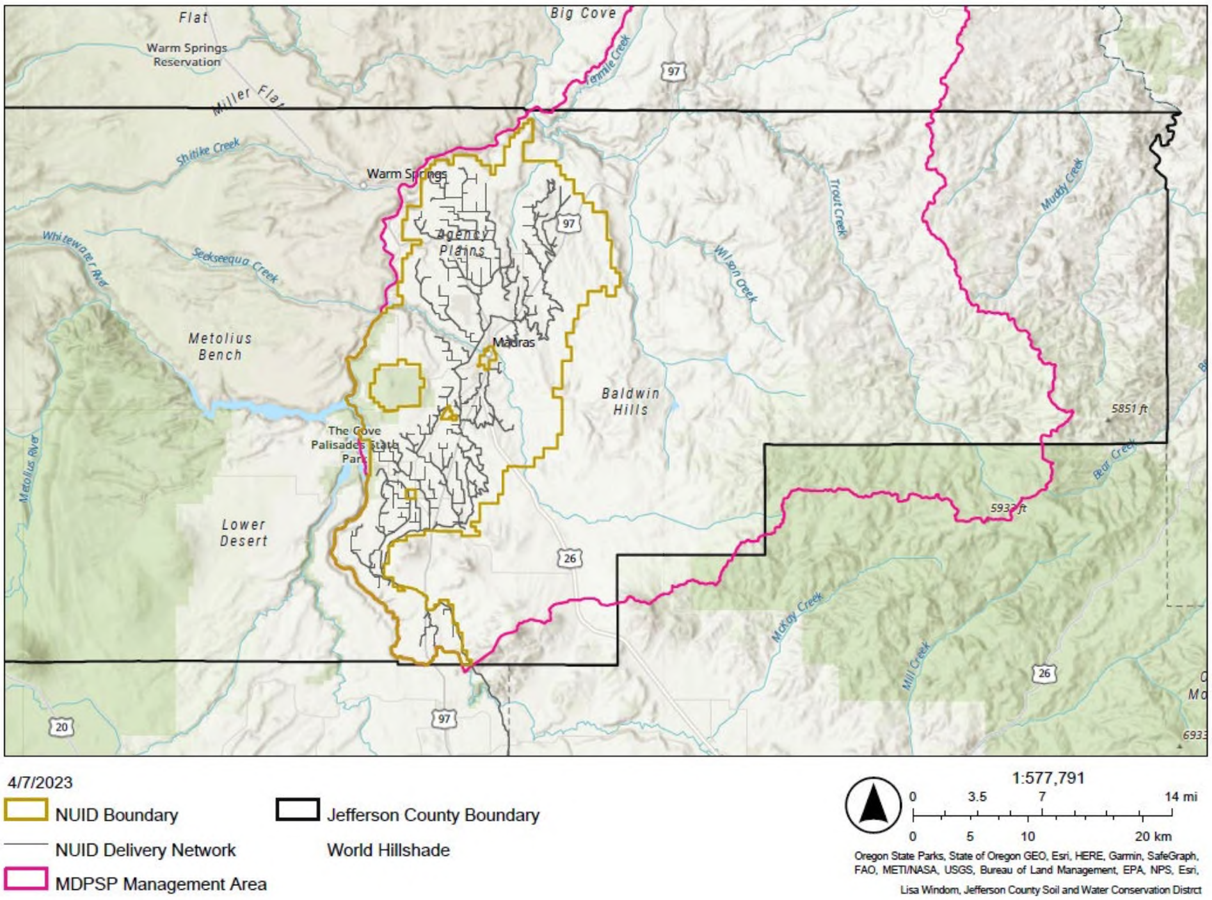

Figure 6. NUID Distribution System and Service Boundary within the Management Area.

Though gravity-fed, operational water is required to transport water through the canal network to the deliveries. Operational water is the additional water diverted to facilitate water transport; it is also called 'carry water' as it helps carry the water to its intended delivery. The amount of operational water varies depending on the cross-sectional area, the slope of the canal of transport and the volume of water being transported. The landowner at the end of each canal receives the operational water and is responsible for its storage and use. When the amount of operational water is too great for the landowner's irrigation pond, it will overflow into a drainage network. This drainage could lead to the neighbor's pond to allow for water reuse, a legacy of the furrow irrigation network, or it could lead directly into the natural drainage leading back to the Deschutes River.

The operation and maintenance of the canal network can be a source of turbid and excess water into the natural drainages. The canals are charged with water in the spring, remain filled throughout the summer, and are drained of water in the fall. The process of filling the canals clears loose soil, weeds and debris that has accumulated within the open canal network and can last over a week. Similarly in the fall, the canal could take over a week to drain the canal network. While draining out, landowners are given the option to open their headgates, irrigate, and fill their ponds to spread the water out across the land, but there continues to be an excess of water that reaches the natural drains. Some of the high turbidity events in April and October can be connected to excess canal discharge and runoff from saturated fields related to this time period.

Growers within the irrigation district have invested heavily in efficient irrigation systems due to limits on irrigation water supply. In the spring of 2023, the SWCD completed an observation inventory of the irrigation equipment on each field and found that a majority of fields were outfitted with sprinkler, pivot, linear, or drip irrigation. However, a minority of fields still applied furrow irrigation and used the historic drainage network. Though the study was still in an early draft during the publishing of this Strategic Plan, the preliminary data shown in Figure 7 provides an invaluable visual. The study shows the cluster of fields in the headwaters of Campbell Creek and Rattlesnake Canyon (a region known as Agency Plains) that were outfitted with furrow irrigation. Note that the study captured what type of irrigation equipment was evident on each field, not whether the field was being irrigated that year or was left fallow.

The clustering of furrow irrigated fields is because the Agency Plains landscape provides a flat, slightly sloped landscape that is more conducive to furrow irrigation than the rolling hills of the Culver Drain or Mud Springs Creek. These fields are connected through a linked drainage network and growers use pump-back systems to re-use the water as much as possible. The high winds of Agency Plains do not impact furrow irrigation and growers claim the shallow bedrock prevents water loss to deep infiltration.

The Campbell Creek watershed has been identified as a region requiring targeted outreach for over a decade because of a cluster of furrow irrigated fields which are known to erode the topsoil and transport suspended soil. The water quality impacts from on-farm management within this region has motivated the creation of the NRCS Agency Plains Conservation Implementation Strategy (CIS) and the ODA Strategic Implementation Area (SIA). These programs provide federal and state funding to improve on-farm resource management in pursuit of water quality through such means as technical support, irrigation upgrades, and piping. The ODA Middle Deschutes Agricultural Water Quality Management Plan outlines on-farm activities necessary to improve water quality, such as improved irrigation water management, stormwater management, cover cropping, and buffer strips which align with methods to reduce pesticide loading in natural drainages as well.

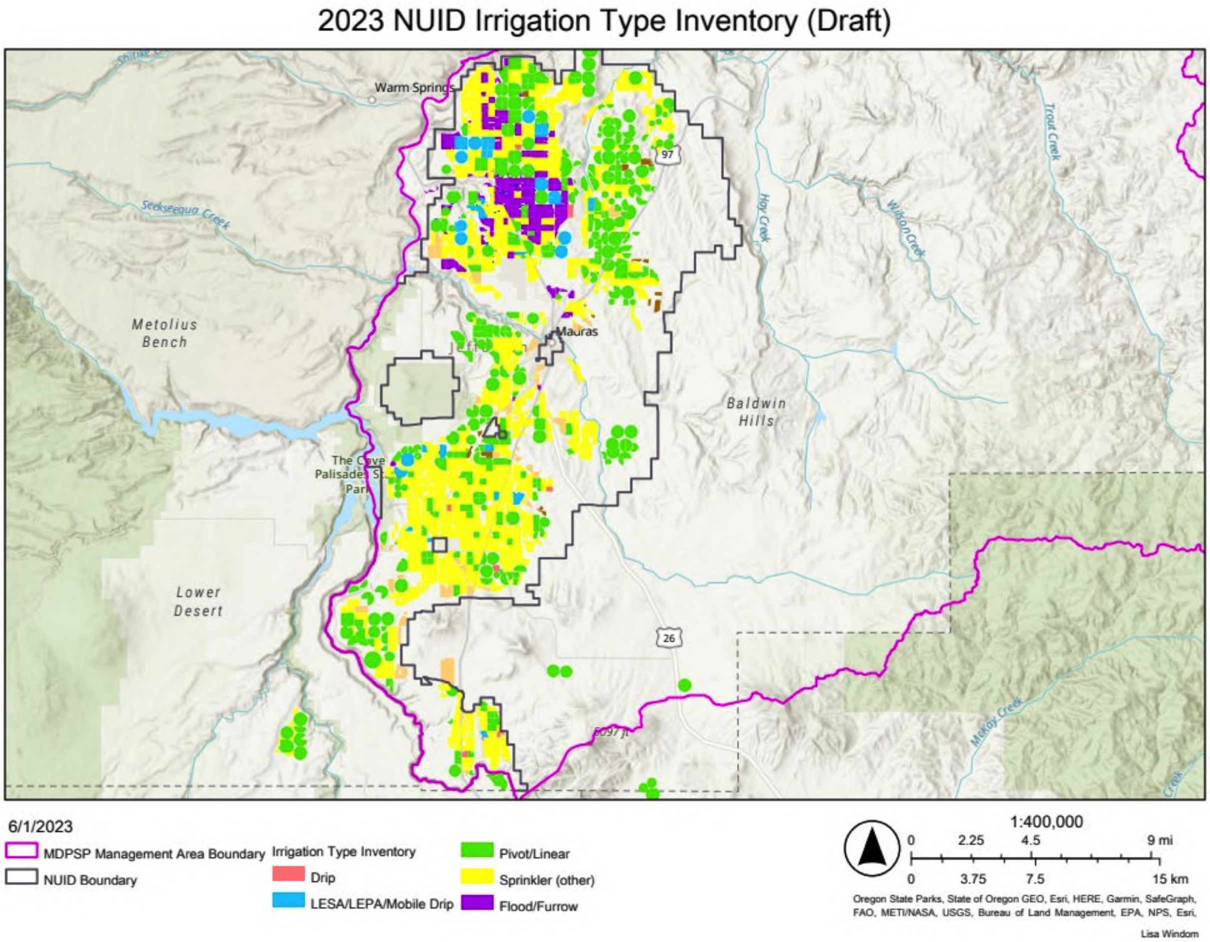

Figure 7. (Draft) 2023 Irrigation Inventory of NUID fields provided by the SWCD.

Whether irrigated by sprinkler, pivot or furrow irrigation, on-farm irrigation management is paramount. Overwatering of any kind can produce turbid water if the soil is exposed, and this turbid runoff could transport pesticides sorbed to the suspended solids into the natural drainages. The furrow irrigation and pump-back network in Agency Plains provides both benefits and risks to water quality downstream. The benefit of this network is that (when working optimally) the pump back system captures the runoff water for reuse on-farm and prevents this turbid water from entering natural drainages. However, the risks are that furrow irrigation produces turbid runoff and this turbid runoff concentrates with suspended solids through the reuse, pump back systems. When the volume of water within the network exceeds what can be pumped back, runoff concentrated with nutrients, pesticides, and suspended soil overflows into the natural drainages. Due to water shortages and improved irrigation management, the amount of overflow from this system is minimal but still captured in the Campbell Creek at Hwy 26 dataset (explained further in Section 2.4.3.3 Pesticide Data by Site). In addition to on-farm runoff, events such as excess carry water from the irrigation district, precipitation events, or an unexpected pump malfunction can also cause excess flow to reach the natural drainages.

2.2.5 Geology and Soil

The Management Area contains a broad array of soil types due to the history of varying volcanic flows through the area. When focusing on the monitored drainages, the diversity in soil type is evident in the Mud Springs Creek headwaters, and along the canyon and cliff walls of each drainage. The cultivated lands of Agency Plains, lower Mud Springs Creek, and the Culver Area are less diverse and provide prime farmland when irrigated. The soils of the area include Agency Plains Loam and Madras Loam. These soils are well-drained and 10-30 inches deep before hitting un-weathered, bedrock (United States Department of Agriculture, 2023).

The Management Area constitutes the far western corner of the John Day Ecological Province. This rugged province is characterized by extensive, geologically eroded, steeply dissected hills of thick, ancient sedimentary materials interspersed with buttes and plateaus capped with basalt or tuffaceous rock (Figure 8). The area around Madras also includes flat to slightly rolling farmlands (Oregon Department of Agriculture, 2020).

During the last 60 million years, Central Oregon has experienced major episodes of volcanic activity interspersed by periods of sedimentation. In the Trout Creek watershed, soils on the north and east facing slopes consist mostly of volcanic ash and loess over or mixed with colluvium of fine to medium textured volcanic ash. The rock content in the soil profile is high. Productivity varies greatly between shallow and deep soils. Plateau tops, upper south-facing slopes, and ridge-tops have very shallow soils and have lower productivity. Lower slopes and drainages, side slopes and swales offer better vegetative growth and regeneration potential. The ash soils in this area potentially can produce large amounts of sediment from accelerated runoff when exposed, compacted, or channeled.

Most soils used for irrigated crops, hay, and pastures are in the *Madras-Agency-Cullius Association.* This consists of moderately deep, well-drained soils on upland terraces and plateaus. Slopes range from 0 to 15 percent. These soils formed in medium-textured windblown deposits and are underlain by gravels and basalt of the Deschutes Formation. The soils are fine loamy and depth to basalt or tuff bedrock is 10 to 40 inches. Wind erosion is a concern if the soils are left unprotected. Sediment from runoff due to over-irrigation or storm events may be moderate to high on slopes greater than 10 percent. *Era* soils are sandy loam with a cobbly substratum, 0-3 percent slopes, and with a depth of over 60-inches to bedrock. They are well drained and occur on mountains. Water erosion is a potential hazard.

The *Capheal y-Reute*r complex occurs in rolling hills and supports rangeland, dryland grain, and pasture. *Capheal y* consists of loamy well-drained soils and has a depth of 20-40 inches to bedrock. *Reuter* soil is 10-20 inches to bedrock and is loamy and well drained. This association is limited by slope, wind erosion, and low available water capacity. Wind erosion is a concern if the soils are left unprotected. The soils are very sensitive to overgrazing and recovery rates can be slow. The very low available water capacity and the shallow depth of the Reuter soil limit the choice of species for range seeding to those that are drought tolerant. The very low available water capacity and moderately rapid permeability should be considered in irrigation water management. Sediment from runoff due to over irrigation or storm events may be moderate to high on slopes greater than 10 percent.

Willowdale-Rail soils are used for irrigated hay and pastureland. Slopes range from 0 to 2 percent. Soils are 40 to 60-inches deep. Willowdale soils are well drained; Rail soils are not. This association is limited by high water table and prone to flooding. Shallow excavations are limited due to water table. Runoff is slow and hazard from erosion is slight. Streambank erosion is high when flooding events occur or when riparian or vegetation condition is poor.

Figure 8.Photo of Trout Creek Watershed, Photo Credit to Victoria Fischella

2.2.6 Native Vegetation

Three general vegetation types occur in the Management Area. The upper Trout and Willow Creek watersheds near the Jefferson/Crook County line consist of coniferous forest dominated by ponderosa pine, Douglas fir, or grand fir. Middle elevations consist primarily of juniper savanna interspersed with treeless grassland (now mostly converted to dryland cropping in the Wasco County portion of the Management Area). Irrigated croplands cover the lower elevation areas known locally as Mud Springs, Gateway, Little Agency Plains, Agency Plains, Culver, Henderson Flat, and Trail Crossing (Oregon Department of Agriculture, 2020).

Juniper density has increased dramatically over the past 90 years. The increase in juniper has reduced the uplands' ability to collect and store precipitation. The potential for recovering rangeland vegetative cover exists if practical ways can be found to control soil erosion and plants such as juniper.

In 2018, the Jefferson County Weed Advisory Committee and Management Area was formed to address noxious weeds in the Management Area. Noxious weeds found in the Management Area include yellow starthistle; Scotch and Canada thistle; Dalmatian toadflax; spotted, diffuse, and Russian knapweed; whitetop; kochia; and teasel. Weeds can affect water quality by providing inadequate soil cover and root mass, which can induce upland and streambank erosion.

2.3 Land Uses

The Management Area is predominantly rural, agricultural lands, with rangeland in the uplands (Figure 9). There are regions of protected federal, state, and tribal lands due to the beauty and value of the landscape. The cities of Metolius, Culver and Gateway are small municipalities along the path of the railroad with populations ranging from 500 to 1,700 (as of 2021). The largest city within the Management Area is Madras which provides for nearly 7,800 residents (as of 2021).

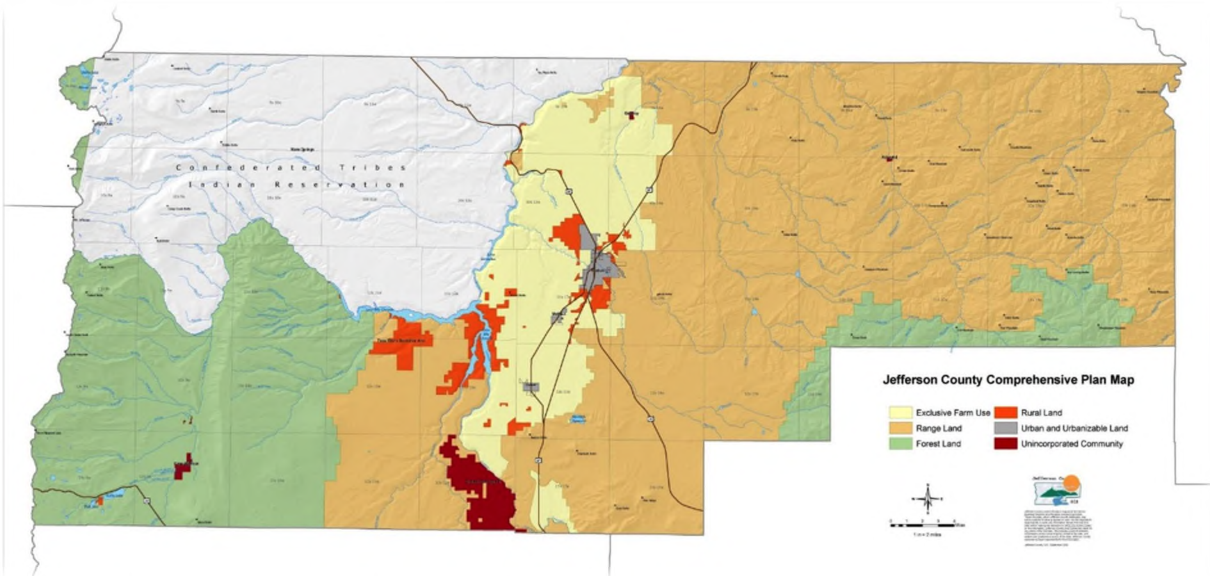

Figure 9. Map of land use in Jefferson County, Oregon. Credit to Jefferson County.

2.3.1 Agriculture

The agricultural region which drains into the Middle Deschutes River is served by NUID which provides irrigation to over 58,800 acres. Irrigated crops include grass seed, alfalfa, seed potatoes, carrot seed, grains, flower seed, hay, nursery crops, herbs, mint, onion seed, garlic, hemp, and some vegetable crops (North Unit Irrigation District, 2022). Non-irrigated crops include hay, small grains, pasture, and perennial vegetation planted under the Conservation Reserve Program (CRP). Alfalfa and other hays are the region's most common crop, but their production of the specialty hybrid carrot seed and Kentucky bluegrass seed puts them on the map across both national and global markets. In the uplands and drainages, outside of the irrigated acres served by NUID, wells and natural springs provide for rangeland grazing and dryland agriculture. There is significant overlap between the agricultural fields and the monitored sub-watersheds of the MDPSP (Figure 10). Recent drought and water shortages have led to mass fallowing of fields and desertification of the landscape.

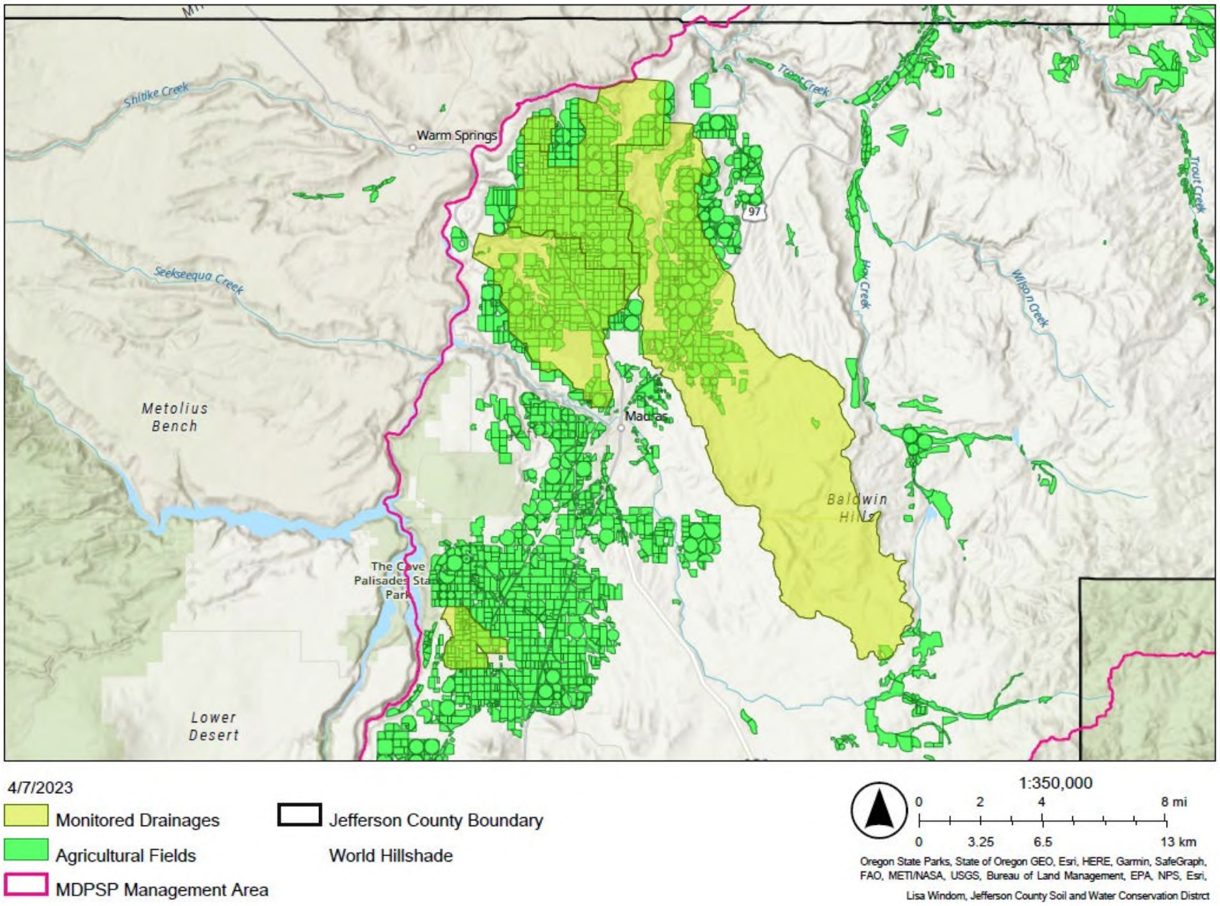

Figure 10. Sub-Watersheds Overlap with Agricultural Fields.

2.3.2 Rights-of-Way

Madras serves as a bottleneck for travel in and out of Central Oregon from the north for both railroad and vehicle rights-of-way. Vehicle traffic from the Portland area and the Columbia Gorge use Highway 26 and Highway 97. These highways cross each other in Madras before continuing to the rest of Central and Southern Oregon. And the only railroad passing through Central Oregon follows the Deschutes River south from the Columbia Gorge until it cuts up Trout Creek and Mud Springs Creek through the town of Gateway and on through Madras.

2.3.3 Public Lands (Federal and State)

Along the Deschutes River, reaches of the cliffs surrounding Lake Billy Chinook are protected as the Cove of the Palisades State Park, the Crooked River National Grasslands, and land protected by Bureau of Indian Affairs (BIA) (Figure 11). There are also multiple day-use and over-night campgrounds along the reservoirs and river which provide iconic salmon and steelhead fishing; these sites are managed by the Bureau of Land management (BLM), BIA, and United States Forest Service (USFS).

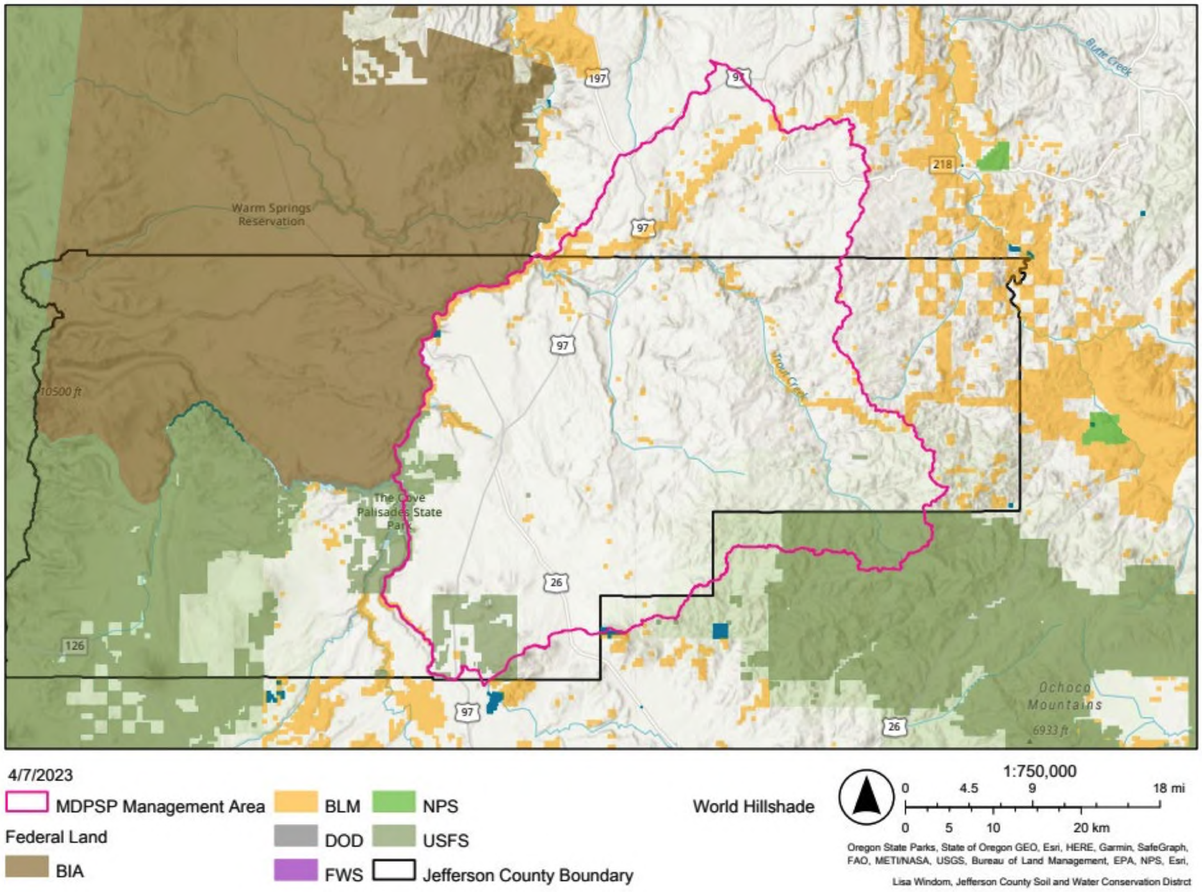

Figure 11. Federal and State Boundaries of Jefferson County and Management Area.

2.4 Water Quality and Management

Before the onset of drought and water shortages, the irrigated acres within Jefferson County were not restricted to an allotment and could use above and beyond their minimum water right. Water usage of about 2.25 acre-feet per acre of irrigatable acres for Deschutes River water rights and 1.25 acre-feet per acre for Crooked River water rights was common. On-farm management had become such a concern that in 2013, the SWCD, the CTWS, landowners, and stakeholders prioritized addressing resource concerns associated with irrigation runoff in the North Agency Plains portion of Jefferson County. Shortly after, the annual Natural Resources Conservation Service (NRCS) Local Working Group added irrigation water conservation as an important concern and organized these efforts into two goals for the Agency Plains Conservation CIS to (1) improve irrigation water efficiency on croplands northwest of Madras, and (2) reduce irrigation tailwater runoff to the Deschutes River below Pelton Dam (Jefferson County Soil and Water Conservation Distrct, 2022). The Agency Plains CIS measures turbidity in Mud Springs, Trout Creek, Campbell Creek and/or Rattlesnake Canyon to track the impact of upstream land use and irrigation water management on natural drainages and to quantify the success of conservation efforts implemented by the NRCS and partners. Agricultural runoff into the natural drainages can originate from on-farm runoff, storm drainage, or discharge from the NUID irrigation canals.

Samples were grabbed regularly throughout the year. The samples were analyzed for turbidity, which measures water clarity, and thus used to measure the amounts of agricultural runoff high in suspended soils.

2.4.1 Water Shortages and Fallowed Fields

Over the past five years, the farmers and ranchers within Jefferson County have faced unprecedented water shortages which have impacted the watershed, community, and economy of the county. NUID has faced water shortages due to drought and changed to headwater management in preservation of the ESA-protected, endangered Oregon spotted frog (OSF). These water shortages can be captured by the restrictive water allotments seen between 2019-2023. These allotments limited the local growers to as high as 65% and as low as 20% of their usual water right (North Unit Irrigation District, 2023). Because most of the agriculture within Jefferson County is irrigated through the NUID water, and NUID canal management impacts the volume of water in natural drainages. The impact of their operations can be seen on-farm, in the drainage water quality, and in the types of conservation projects being explored by landowners. The ripple effect from these water shortages can be seen in ongoing water studies.

2.4.1.1 Deschutes Basin Habitat Conservation Plan

Though outside the Management Area, the impact of the Deschutes Basin Habitat Conservation Plan (HCP) must be acknowledged because its rippling impacts can be seen in ongoing water quality studies, regional land use/economic challenges, and the necessary designs for sustainable conservation projects. After over a decade of work, the HCP was finalized and put fully into effect in December 2020 which adjusted the management of Crane Prairie Reservoir, Crescent Reservoir, Wickiup Reservoir, and the Upper Deschutes River in preservation of the endangered OSF (U.S. Fish and Wildlife Service, 2020). This plan included eight irrigation districts of the Deschutes Basin, represented by the Deschutes Basin Board of Control (DBBC), and the City of Prineville. As the junior water right holder of the Upper Deschutes River and manager of Wickiup Dam, NUID is held responsible for many of the major changes outlined in the HCP. NUID stores over 80% of its water supply within Wickiup Reservoir and transports it through the Deschutes River from Wickiup Dam to its diversion in Bend (North Unit Irrigation District, 2019). It is no coincidence for this overlap, sighting the purpose of the HCP being to counteract the ecological damage that has occurred due to irrigation water management between the storage reservoirs on the headwards to the diversions within Bend city limits.

Without getting into the details of the HCP (please refer directly to the public document for further clarification), the follow are three of the most noticeable changes to the dam management whose impacts can be seen in Jefferson County (Jefferson County Soil and Water Conservation Distrct, 2022):

1. Winter discharge from Wickiup Reservoir has increased to provide water for OSF overwintering- as a result Wickiup Reservoir does not fill at the same rate and requires more precipitation to match historic filling trends.

2. March and April discharge from Wickiup Reservoir must be increased to 600 cfs (depending on USFWS guidance) to provide for OSF reproduction- as a result more water than what is necessary to meet irrigation demands is released, encouraging NUID to divert water and charge irrigation canals to excess to avoid missing out of divertible water.
3. Allowable peak flows in May-August were reduced below historic demand- as a result NUID was required to lower water usage by regulating water users.

Depending on the climate, timing of precipitation and heat waves, and historic groundwater storage, these changes in management have varying impact on the resource management within Jefferson County.

2.4.1.2 Drought hits the Deschutes Basin

The Deschutes Basin Watershed (and Jefferson County within) have been in Severe to Exceptional Drought (as per NOAA and the NIDIS referenced at Drought.gov) from 2019 to 2023. The drought has led to depleted groundwater supplies in the Cascades which equate to a reduction in water storage in the reservoirs and runoff in the summer and fall. And it led to an increase in on-farm demand due to depleted soil moisture. Compound this drought with irregular heatwave in May-August and the adjustments made by the HCP, Jefferson County found itself in a water shortage unseen in its history. The percentage of fields left fallow have increased from 11% in 2018 to 19% in 2019, 27% in 2020, and 36% in 2021. Historically, an average of 6,000 acres (10%) were left fallow each year, but in 2022, the number of fields left fallow reached historic highs with 24,000 acres (41%) left fallow and dry (North Unit Irrigation District, 2022).

2.4.2 Turbidity

The turbidity is monitored throughout the year within Campbell Creek, Mud Springs, and Culver Drain and provides insight on water and land management upstream. Figure 12 shows the turbidity of samples collected throughout the 2022 irrigation season; this graph provides a good representation of common trends observed within each drainage. The turbidity was continuously higher in Campbell Creek, which receives drainages from the network of furrow irrigated fields. Mud Springs Creek experienced higher turbidity in the springs as a result of precipitation and excess discharge from charging of the canal network. And the Culver Drain remained fairly clear of turbidity.

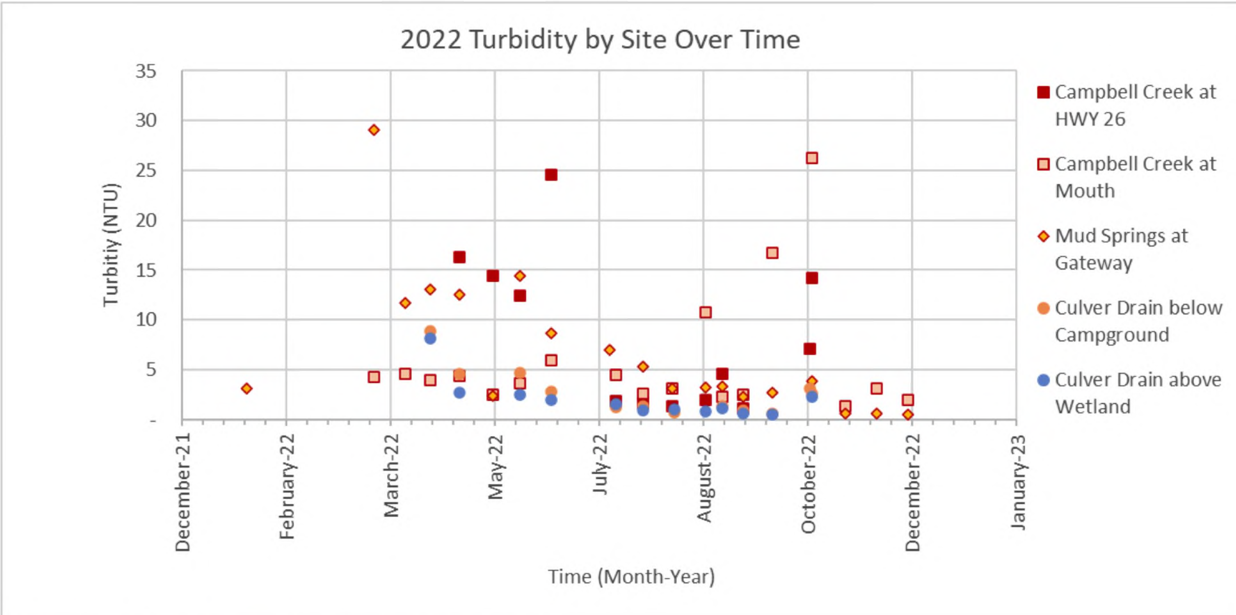

Figure 12. Turbidity in Sampled Drainages throughout 2022

The impact and subsequent learning curve to overcome water shortages can be seen in the turbidity collected throughout the years. In Figure 13, there is a spike in turbidity in 2019 as water shortages first start increasing the number of acres left fallow and a wet spring led to turbid drainage from the unplanted fields (Jefferson County Soil and Water Conservation Distrct, 2022). However, with time the growers learned to adapt on-farm management to reduce topsoil loss, and operate as efficiently as possible, therefore reducing the turbidity reaching natural drainages. Tools such as irrigation management, cover crops, and no-till seeding were used to limit soil disturbance and irrigation runoff. The region also became extremely dry, which increased the absorption of runoff within the field buffers and surrounding ditches and lowered the volume of runoff that would reach the natural drainages.

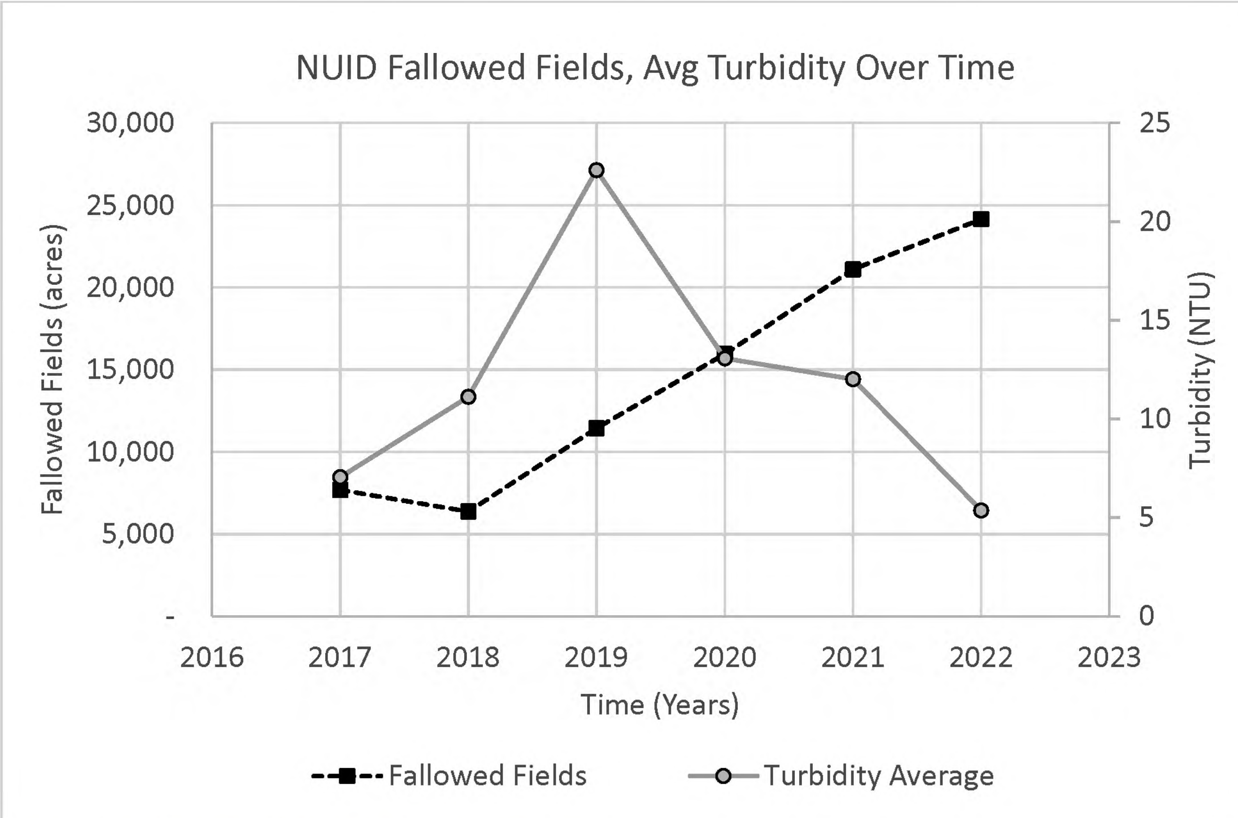

Figure 13. NUID Fallowed Fields, Average Turbidity over Time.

2.4.3 Pesticides

The Oregon PSP analyzes samples for over 130 pesticides commonly used throughout the state. Collaborative discussions among the WQPMT and partners may add pesticides to this list based on concern or interest. Since the start of its pilot, the MDPSP has detected dozens of pesticides within its natural drainages. The relative detection of these pesticides varies from year to year based on water availability and management among the cultivated fields of the headwaters. The types of pesticides detected coincide with the common pesticides used for the locally grown crops, and the management of rights-of-way and peripheral lands.

2.4.3.1 Aquatic Life Benchmark

The concentration of each detected pesticide is compared to the aquatic life benchmark (ALB) which is established by informed research and peer-reviewed studies. As shown in Figure 14, a pesticide can be detected frequently without exceeding or approach its ALB. In the MDPSP, pesticides (and degradants) such as AMPA, Glyphosate, and Azoxystrobin are frequently detected at concentrations below their subsequent ALBs. While Linuron and Diuron have both been detected at high frequencies and at concentrations that approach or exceed their ALBs. Both the detection frequency and concentration are considered when prioritizing pesticides of concern, in the development of the Strategic Plan goals presented in later sections.

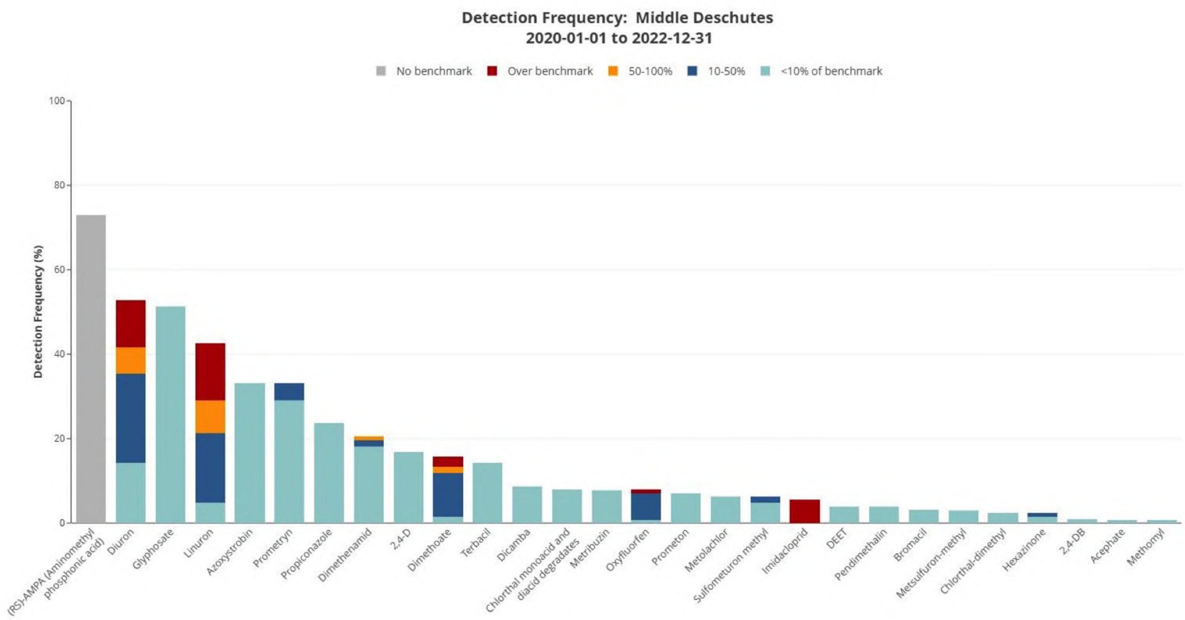

Figure 14. Detection Frequency of the Pesticides of the Middle Deschutes Pesticide Stewardship Partnership, 2020-2022

2.4.3.2 Aquatic Life Ratio

In order to evenly compare the detected concentrations of different pesticides, the aquatic life ratio (ALR) is used. The ALR divides the detected concentration by the ALB to normalize the data. If the ratio is one, the two values are equal; if the ratio is greater than one, then the concentration exceeds the benchmark value. The ALR normalizes the detected concentrations so an even comparison can be made among the different pesticides and the magnitude by which the ALB has been surpassed can be easily understood. As shown in Figure 15, the ALR of the highest detected concentrations of 2022 are compared. The horizontal line denotes where the ALB equals the ALR; Diuron, Linuron and Imidacloprid were detected at values two to twelve times their ALB.

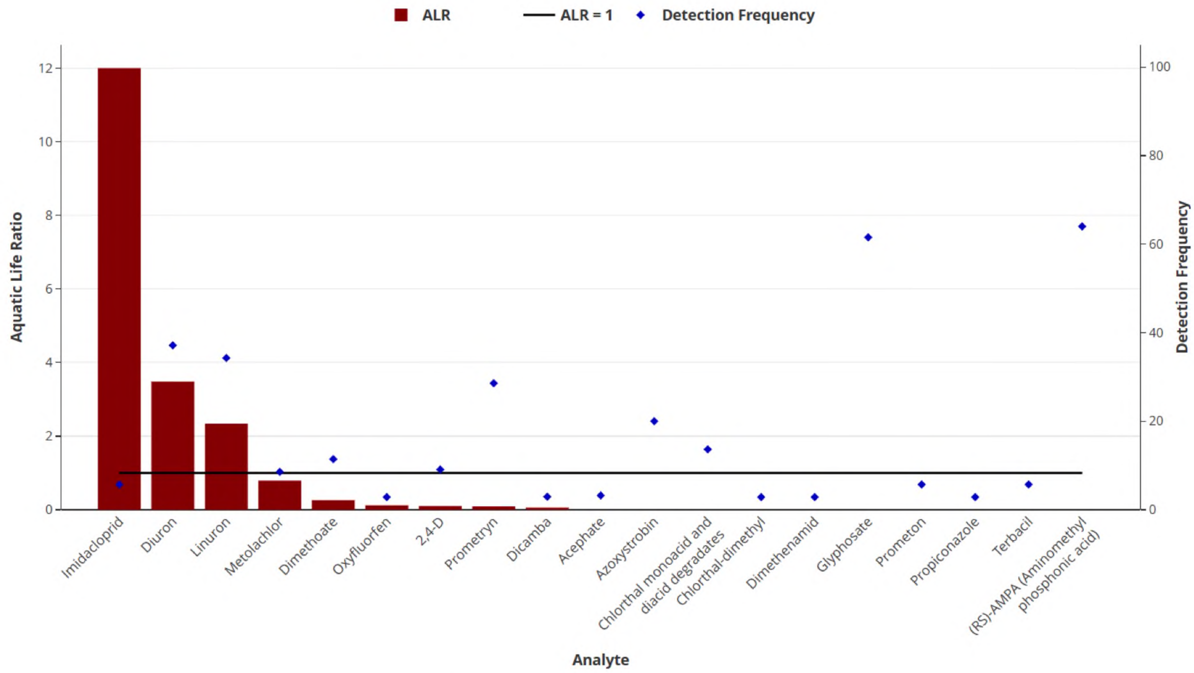

Figure 15. Aquatic Life Ratio, Detection Frequency of Pesticides within the Middle Deschutes in 2022

2.4.3.3 Pesticide Data

Looking deeper into at Diuron, Linuron and Imidacloprid (which each exceeded their ALR in 2022) the location of detection is considered to track down the source of the high concentrations and the potential method of transport. Based on the nature of sampling, these pesticides are transported by suspended solids in drainage water or dissolved into the runoff water itself. The turbidity trends (shown in Figure 12 in Section 2.4.2 Turbidity) provide insight into the transport mechanism of these pesticides within the Middle Deschutes system.

In Figure 16, the detected concentration of Linuron over time at each sample site shows that a majority of the samples that exceeded the ALB were from Campbell Creek at Hwy 26. This sample site receives turbid drainage from one of the last irrigation ponds in a network of furrow irrigated fields before it drains into the natural landscape of Campbell Creek. Linuron does not have a complete environmental fate assessment from the EPA, but it is known to be moderately persistent in course-textured soils and degrades quickly through microbial degradation in water (Environmental Protection Agency, 1995). High concentrations of Linuron are also seen in all the drainages in the spring when irrigation season start up causes a flush of turbid runoff to reach the drainages.

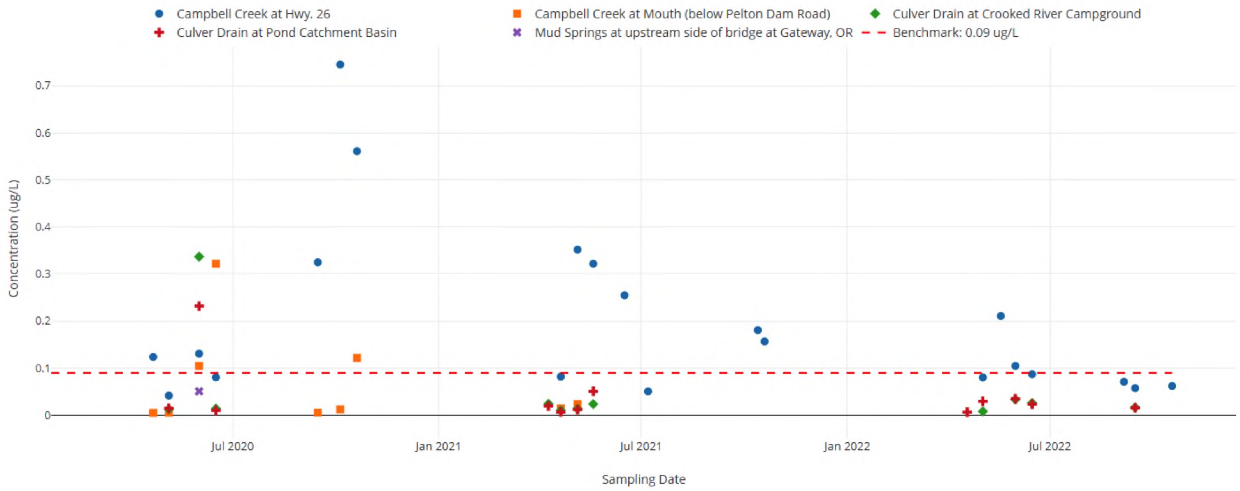

Figure 16 Detected Concentration of Linuron over time, by Sample Site (2020-2022)

In Figure 17, the detected concentrations of Diuron over time at each sample site show that both samples collected in the Culver Drain and Campbell Creek appear to exceed the ALB. The Culver Drain receives drainage from exclusively sprinkler and pivot irrigated fields and the water is usually low in turbidity. The irrigation drainage first reaches the Culver Drain at the Catchment Pond sampling site before passing through a constructed wetland, then a manicured campground, before reaching the Culver Drain at the Crooked River Campground sampling site. If a pesticide is detected at the upper site, it is attributed to irrigation runoff, where if a pesticide is higher or only detected at the lower site, it is attributed to the campground management. The highly manicured campground could be a source of Diuron, especially considering that Diuron was not detected 200 ft upstream at the Culver Drain at the Catchment Pond site that same day. Diuron is highly persistent in soil, and moderately soluble in water; once dissolved with water it is highly persistent (Northwest Center for Alternatives to Pesticides, 2017).

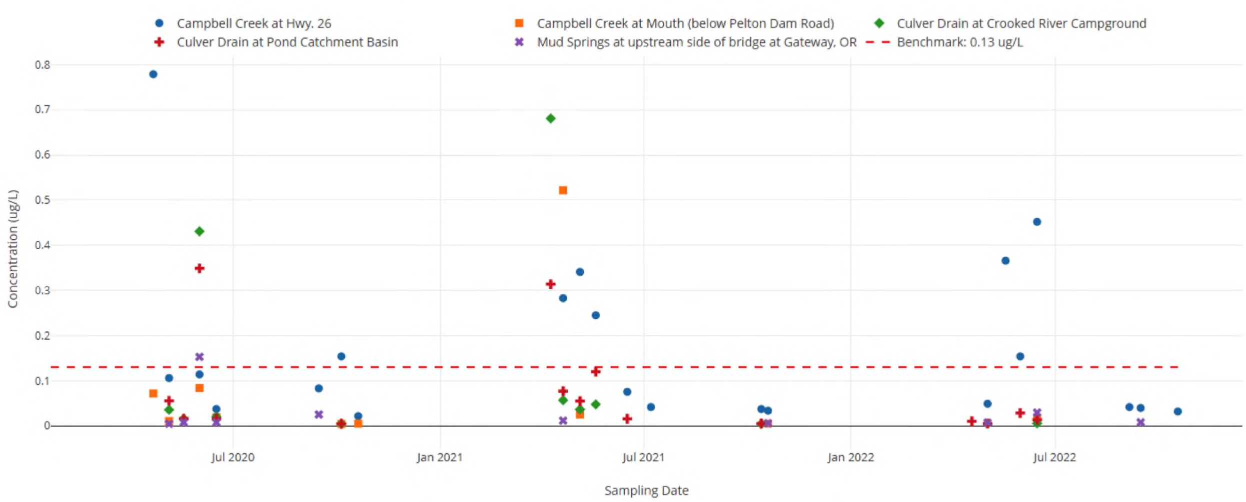

Figure 17 Detected Concentration of Diuron over time, by Sample Site (2020-2022)

And in Figure 18, the detected concentrations of Imidacloprid over time by sample site shows that this pesticide is only detected in the Culver Drain and because the ALB concentration is so low, every detection exceeded it. Similar to Diuron, the concentration of Imidacloprid appear to increase between the Pond Catchment Basin and the Crooked River Campground sampling sites. This suggests that Imidacloprid is being used upstream on-farm and around the campground to management pests. Imidacloprid is moderately soluble, highly persistent in soils and has a high potential to leach into groundwater (Northwest Center for Alternatives to Pesticides, 2017). In the next section, this data will further be analyzed to prioritize target pesticides and establish measurable goals.

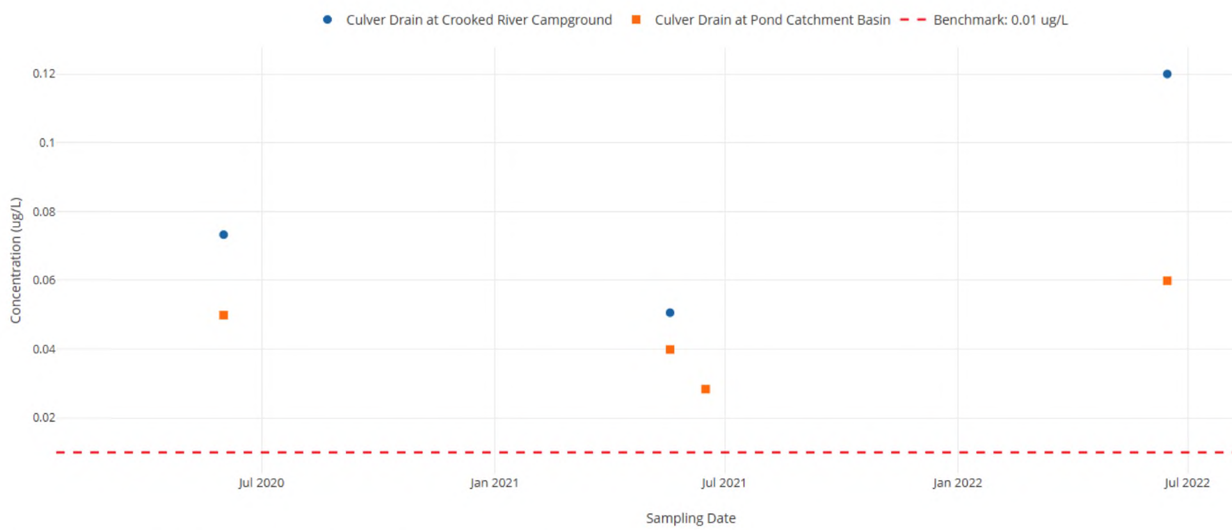

Figure 18 Detected Concentration of Imidacloprid over time, by Sample Site (2020-2022)

Section 3. Implementation Strategy

The MDPSP Strategic Plan targets a list of pesticides that have been detected frequently and at concerning concentrations. They are identified using an evaluation protocol developed by the Environmental Protection Agency (EPA) Region 10 to help prioritize outreach for each pesticide. Locally, the MDPSP applies a communication plan designed to reach pesticide users, and those who support the community through technical support. The communication plan applies goals, strategies, and metrics to organize staff energy to connect with the community and collaborate with local technical advisors (agronomists, extension service, chemical suppliers, etc.). Through targeted outreach and collaborative investigation, effective solutions can be applied to reduce pesticide transport. The pesticide goals pertain to the frequency and concentration of the pesticides detected, with an overall finality of lowering all detected pesticides below the "high level of concern" ranking.

3.1 Determination of Pesticides of Concern

In 2019, the EPA Region 10, which includes Idaho, Oregon, and Washington, developed a matrix to evaluate the status of their pesticides in surface water. The matrix is based on both concentration and frequency of detection and incorporates both acute and chronic ALB developed by the U.S. Environmental Protection Agency (Reinholtz, 2021). The MDPSP applies this decision matrix as a prioritization tool. As show in the Figure 19, pesticides are rated as Low, Moderate, or High, depending on the detection frequency, concentration, and research-based thresholds of each detected pesticide. The boxes further break down the reason leading to the concern, whether the pesticide was detected frequently, at high concentrations, or both. This analysis looks at the past three years of data to prioritize the detected pesticides, and the list of pesticides of concern is updated annually.

Reference Level Criteria

Frequency of Detection in Last 3 Years (%)	≥ 1 detection at or above 50% of an acute ALB	≥ 3 detection at or above 50% of a chronic ALB	1 to 2 detections at or above 50% of a chronic ALB	No detections over 50% of any ALB
65.1% - 100%	High Level of Concern	High Level of Concern	High Level of Concern	Moderate Level of Concern
35.1% - 65%	High Level of Concern	High Level of Concern	Moderate Level of Concern	Moderate Level of Concern
0% to 35%	High Level of Concern	High Level of Concern	Moderate Level of Concern	Low Level of Concern

Figure 19. Decision Matrix to Rate Detected Pesticide by "Level of Concern"

3.2 Pesticides of Concern, Pesticides of Interest

Pesticides detected within the MDPSP are categorized by using the state approved decision matrix. The pesticides of high, moderate, and low concern in the MDPSP as of 2023, based on the sampling results from 2020-2022, are presented in Table 1. Seven pesticides were found to have a high level of concern, two pesticides (and degradants) were rated as having a moderate level of concern, and the remaining nineteen were considered to be detected at a low level of concern.

Table 1. Middle Deschutes Pesticides of Concern.

Middle Deschutes Water Quality 2023 Detected Pesticides, rated low, moderate, or high level of concern.				
Frequency of Detection	≥ 1 detection at or above 50% of an *acute* ALB	≥ 3 detections at or above 50% of a *chronic* ALB	1 to 2 detections at or above 50% of a *chronic* ALB	No detection above 50% of any ALB
100 to 65.1				AMPA (Aminomethyl phosphonic acid)
65 to 35.1	Linuron Diuron			Glyphosate
35 to 0	Dimethoate Oxyfluorfen Dimethenamid Metolachlor	Imidacloprid		Azoxystrobin Prometryn Propiconazole 2,4-D Terbacil Dicamba Metribuzin Prometon Sulfometuron methyl Chlorthal monoacid and diacid degradates DEET Pendimethalin Bromacil Chlorthal-dimethyl Hexazinone Metsulfuron-methyl 2,4-DB Acephate Methomyl

The MDPSP applied the decision matrix to prioritize the list of detected pesticides; the planning team then subdivided the list into local pesticides of interest (POI), Pesticides of Concern (POC), and, as applied in the Middle Rogue PSP, Local Problem Pesticides (LPP) (Speece, 2019). This subdivision allows for equitable outreach and effective pooling of limited resources. Pesticides of Interest are those pesticides that have been identified to have the potential to occur at concentrations approaching or exceeding known ALBs. Pesticides of Concern are a POI which is determined to approach or exceed an ALB, thus posing possible risks to human or ecological life

(Pesticide Management Plan for Water Quality Protection, 2011). The LPP is a POC pesticide that has been classified by the MDPSP as requiring particular attention and mitigation efforts. The MDPSP considered the ALR when determining the list of LPP.

In Table 2, the MDPSP further reorganizes the list of pesticides into POI, POC, and LPP. The list of MDPSP POI include pesticides that have been labeled low to moderate level of concern. These pesticides should be watched due to their detected presence but are currently at a low risk to approach or exceed ALBs. The MDPSP POC include four of the seven pesticides rated as having a high level of concern. And the MDPSP LPP focus on the three POCs rated as a high level of concern and were detected exceeding the ALR in the 2022 sampling season.

Table 2. MDPSP Pesticides of Interest, Pesticides of Concern, Local Problem Pesticides

MDPSP Pesticides of Interest	MDPSP Pesticides of Concern	MDPSP Local Problem Pesticides
Glyphosate RS)-AMPA (Aminomethyl phosphonic acid) Azoxystrobin Prometryn Propiconazole 2,4-D Terbacil Dicamba Metribuzin Prometon Sulfometuron methyl Chlorthal monoacid and diacid degradates DEET Pendimethalin Bromacil Chlorthal-dimethyl Hexazinone Metsulfuron-methyl 2,4-DB Acephate Methomyl	Dimethoate Oxyfluorfen Dimethenamid Metolachlor	Imidacloprid Linuron Diuron

3.3 Middle Deschutes PSP Monitoring

The monitoring locations focused on natural drainages which drained off irrigated agricultural lands of Agency Plains, Culver, or Gateway. Throughout the MDPSP pilot and the planning of the Strategic Plan the monitoring locations included two sites within Campbell Creek, two sites within the Culver Drain, and one site within Mud Springs Creek. These sampling locations are listed in Table 3 and shown in Figures 20 and 21.

Figure 20. 2019-2022 Sampling Sites: (a) Campbell Creek at Mouth, (b) Mud Springs Creek, (c) Culver Drain below Campground, photo credit to Lisa Windom.

Table 3. MDPSP Sampling Locations 2019-2022

Drainage	Location	DEQ Sample ID	Continue or Change with Strategic Plan
Campbell Creek	At Hwy 26 and Columbia	35226	Continue annually
Campbell Creek	At Mouth to Deschutes River	37635	Continue annually
Mud Springs	At Gateway	34797	Change to biannually
Culver Drain	At Crooked River Campground	38827	Continue annually
Culver Drain	Above wetland	40773	Removed and replaced with Rattlesnake Canyon site

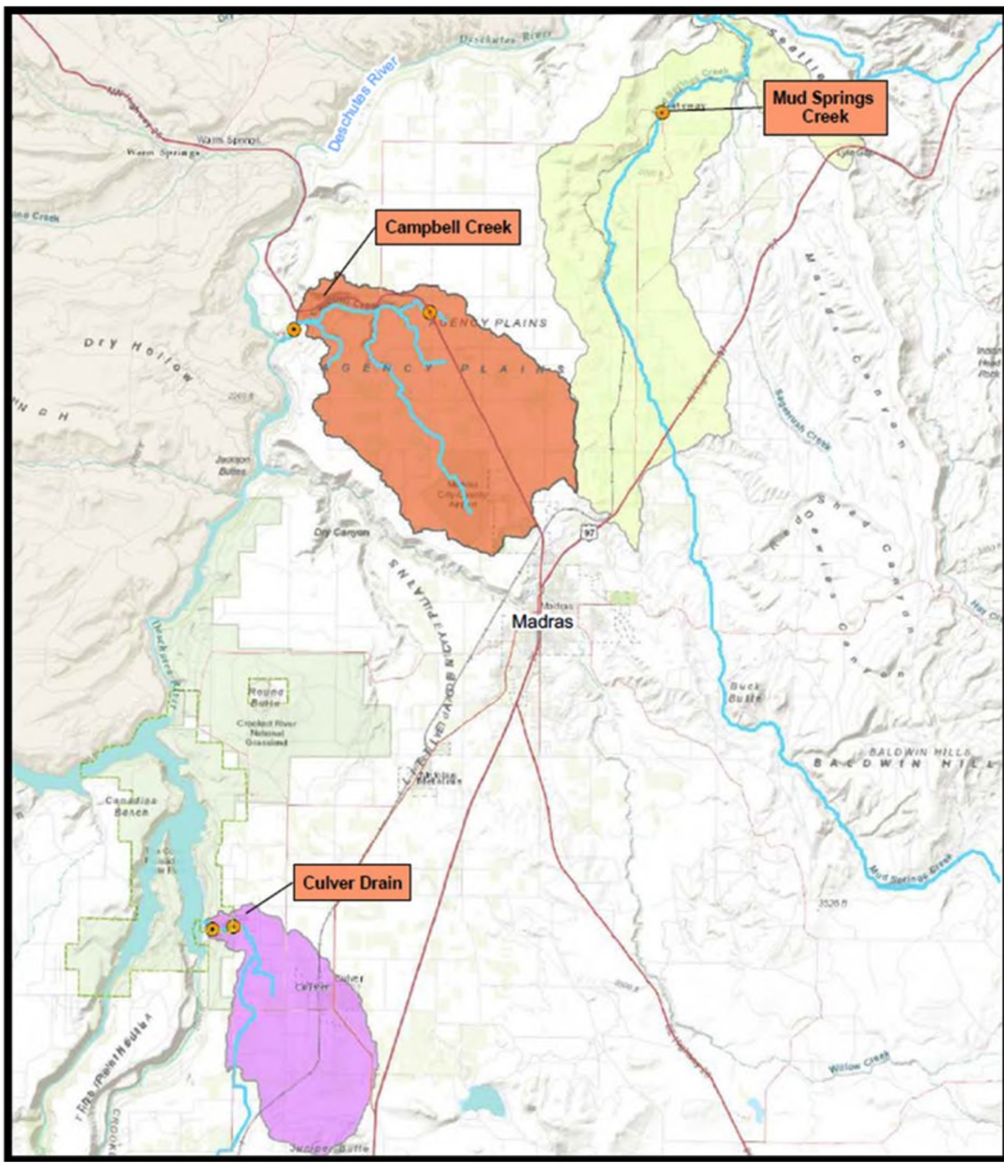

Figure 21. MDPSP Sampling Locations 2019-2022

Campbell Creek drains from the agricultural lands of Agency Plains and provide intermittent flow to the Middle Deschutes River. Samples are collected both at the top on Agency Plains (Campbell Creek at Hwy 26) and down within Campbell Creek at the mouth before it drains into the Middle Deschutes River (Campbell Creek at Mouth). Mud Springs Creek drains from the agricultural region in Gateway (Mud Springs Creek at Gateway) and is a tributary to Trout Creek. Trout Creek is a major tributary to the Deschutes River and serves as a major spawning ground for summer steelhead. The Culver Drain accumulates agricultural and storm runoff from the agricultural region surrounding the City of Culver and runs it through a wetland before draining into Lake Billy Chinook. Samples are collected before (Culver Drain upstream of Pond Catchment Basin) and after the wetland (Culver Drain at the Crooker River Campground).

With the implementation of the Strategic Plan, the MDPSP rearranged its sampling scheme to include the Frog Springs and Rattlesnake Canyon watersheds without changing the total number of samples (Table 4, Figure 22). Instead of sampling above the wetland in the Culver Drain, the MDPSP will sample at the rim of Rattlesnake Canyon within the agricultural runoff draining into the canyon. And instead of sampling every year at Mud Springs Creek in Gateway, sampling will switch every other year between the Frog Springs drainage and Mud Springs Creek. This allows the MDPSP to explore additional drainages without increasing the load on staff, funding, and time. Frog Springs will be sampled where it crosses Juniper Road, above the three collection ponds.

Table 4. MDPSP Sampling Locations 2023-2025

Drainage	**Location**	**DEQ Sample ID**	**Annually/biannually**
Campbell Creek	At Hwy 26 and Columbia	35226	Annually
Campbell Creek	At Mouth to Deschutes River	37635	Annually
Mud Springs	At Gateway	34797	Biannually
Culver Drain	At Crooked River Campground	38827	Annually
Frog Springs	At Juniper Road	TBD	Biannually (trade off with Mud Springs)
Rattlesnake Canyon	At Rim, post irrigation pond	35227	Annually

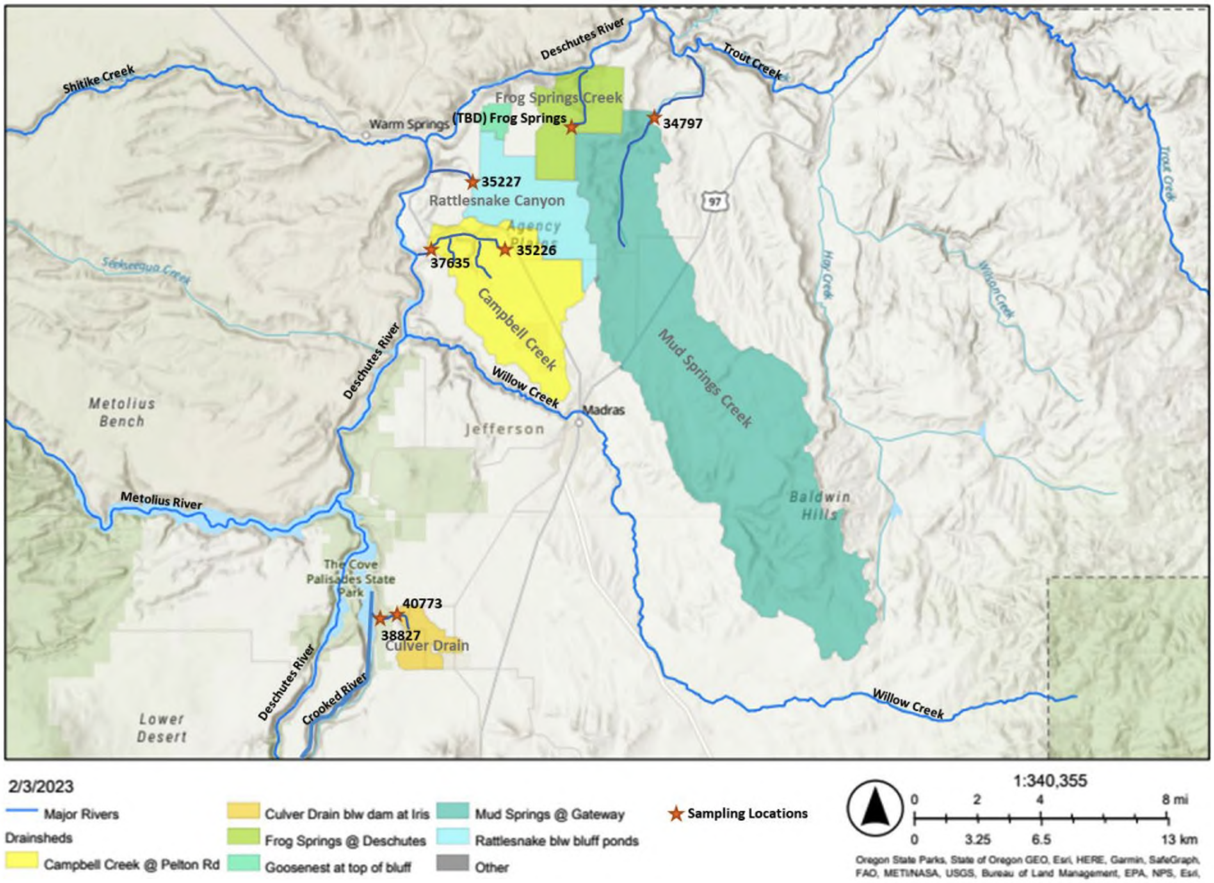

Figure 22. MDPSP Monitored Sub-Watersheds and Sampling Locations

3.4 Critical Areas

When identifying critical areas, factors such as land management, regional hydrology, and pesticide usage were considered. The pesticides identified as POCs and LPPs were predominantly transported by water or suspended soil in water, making the management of irrigation, stormwater, and runoff an important component. A majority of the land within the Management Area is managed by medium to large industrial farms who apply irrigation water from a network of open and piped irrigation canals. And considering that the top POCs and LPP are applied on specialty crops such as hybrid carrot seed, Kentucky bluegrass seed, alfalfa hay, and vegetable crops, the agricultural regions within the Management Area proved to be a critical area of focus.

To further identify target regions for outreach, the MDPSP explored the pesticides of concern at the sub-watershed scale. Table 5 shows a list of the pesticides ranked as moderate to high level of concern, across all samples and sub-divided by sub-watershed. The Overall column refers to the combined data for the past three years, provided by the DEQ decision matrix. When breaking down the POC/LPP by sub-watershed, it was discovered that the Campbell Creek drainage consistently detected the POCs/LPPs at high levels of concern. The Culver Drain and Mud Springs Creek detected the POCs/LPPs but not all pesticides were detected at concentrations as high or as frequent. This suggests the need to prioritize outreach and technical investigation to the Campbell Creek watershed, followed by the Culver Drain, and then the Mud Springs Creek drainage. This prioritization led to the choice to switch between Mud Springs Creek and Frog Springs during the sampling season because of the reduced number of pesticides detected at moderate to high levels of concern within Mud Springs Creek.

Table 5. Moderate to High Rated Pesticides of Concern by Sub-Watershed

Pesticides of Concern (POC)		Level of Concern		
Pesticide Name	Overall (2020-2022)	Campbell Creek	Culver Drain	Mud Springs Creek
Dimethenamid	High	High	Low	Low
Dimethoate	High	High	High	Low
Diuron	High	High	High	High
Imidacloprid	High	High	High	Low
Linuron	High	High	High	High
Oxyfluorfen	High	High	Low	Low
Prometryn	High	High	Moderate	Low
AMPA	Moderate	Moderate	Moderate	Moderate
Glyphosate	Moderate	Moderate	Moderate	Moderate

3.5 Target Pesticide Users

Based on the major use for the priority list of POC/LPPs targeted by the Strategic Plan, there is a short list of pesticides users to target (Table 6). The target pesticide users are industrial farmers growing grass seed, hybrid carrot seed, alfalfa, and vegetable crops or those managing rights-of-way and associated lands (fence row, stack yard, perimeters, etc). To best target these pesticide users, the MDPSP will target growers based on the crops they are growing to provide informed alternative methods or best management practices. These pesticide users are highly educated in their trade and face great risks to their livelihood when experiments fail. Providing respectful outreach focused on crop growth, established science, economic risks and rewards, and relevant case studies will help find solutions that are effective and valued by the community.

Table 6. MDPSP POC, LPP by Trade Name and Major Use.

	Type H=Herbicide I=Insecticide	Trade name	Major use
Dimethenamid	H	Outlook	Grass seed
Dimethoate	I	Various generics	Grass seed, alfalfa
Diuron	H	Karmex, Direx, generics	Bluegrass seed, Associated Lands (fence row/ farmyard/ stack yard/ rights-of-way)
Imidacloprid	I	Merit, Admire, generics	Vegetable crop
Linuron	H	Lorex, Lines	Carrot seed
Oxyfluorfen	H	Goal, Galigan, generics	Carrot and bluegrass seed
Prometryn	H	Caparol	Carrot seed

3.6 Measurable Objectives and Strategic Initiatives

The Oregon PSP program focuses on community education and collaboration to reduce pesticides in natural waters, in lieu of regulation. The goals developed to achieve this can be categorized into communication goals and pesticide goals. The communication goals outline the outreach and technical approach to promote change in the community and the pesticide goals quantify the impact of the outreach on the detection of pesticides in natural waters.

As shown in Figure 23, there are multiple levels of outreach to target each pesticides group (POI, POC and LPP). Broad outreach focused on responsible pesticide management, best management practices, and general land management will target all pesticides from POI to LPP. Focused outreach based on the crop grown, location of use or irrigation practice will target the list of POCs. And collaborative outreach among and alongside local chemical companies, extension services and conservation groups will apply more tactical outreach and problem-solving to address the list of LPPs.

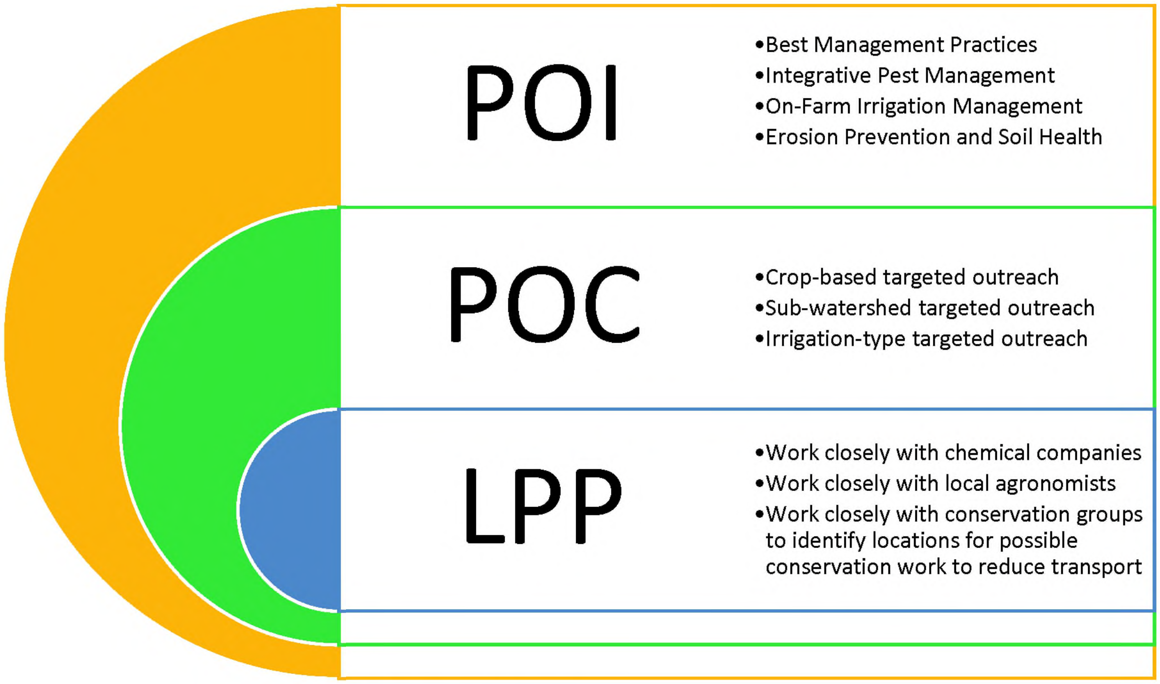

Figure 23. Levels of Outreach to Address POI, POC, and LPP

3.6.1 Communication Goals

The Strategic Plan outlines five years of targeted outreach to reduce pesticide loading in the Middle Deschutes River. As shown in Figure 24, the plan outlines two overarching approaches: (1) to collaborate laterally with local technical support staff throughout the community (such as local agronomists and university extension services), and (2) to provide targeted outreach to the pesticide users.

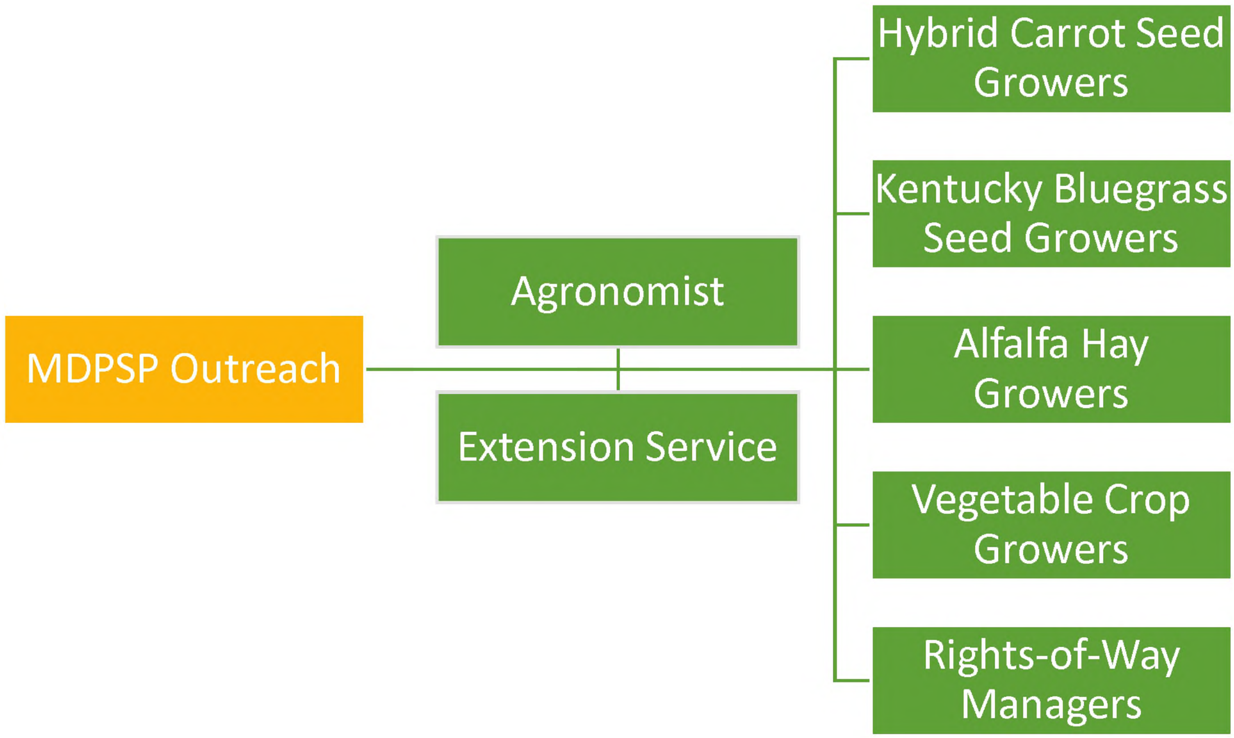

Figure 24. MSPSP Communication Approach: Laterally to Technical Support Staff, Vertically to Pesticide Users.

The pesticide users can be sub-grouped further into seed growers, those managing rights-of-way, and urban households. By first working directly with the local agronomists, chemical companies, seed contractors, OSU Extension Service, and growers, we ensure that the tools used to reduce pesticide transport are relevant, and achievable. From there, we spread the knowledge of these tools through the growers, the agronomists and chemical sales team, partnering entities, and directly to the public. Through care in developing these partnerships, we ensure our approach is a conversation between our team and pesticide users, rather than a one-sided information dump.

There are seven high Pesticides of Concern within this watershed as of 2023: Dimethenamid, Dimethoate, Diuron, Imidacloprid, Linuron, Oxyfluorfen, and Prometryn. All seven are the target of outreach through this plan, though Diuron, Imidacloprid, and Linuron have been identified as LPP and are slightly higher in priority due to the frequency and concentration they are detected. Table 7 outlines the goals. These goals provide strategies and metrics planned to develop reasonable solutions that are attainable for pesticide users (Goal 1), develop resources and readily available resources for the public (Goal 2), and expand the reach of partnerships throughout the community (Goal 3). It is anticipated that this targeted outreach will address activities that may have led to these pesticides making this list. By focusing on outreach related to the vector of transport through soil and water movement, the community can apply these tools so that fewer pesticides reach the natural waters (which will lead to the measurable pesticide goals in Table 8).

Table 7. MDPSP Communication Goals, Strategies, and Metrics

Goals for Communication and Outreach		
Goal 1: Work with and between sector groups to increase knowledge of barriers to implementation of best management practices		
	Strategy 1: Produce targeted campaigns to present best management practices and pest management strategies.	
		Metric 1: Reach out to 3 local chemical companies to make contact and develop relationship.
	Strategy 2: Connect with the community through technical staff of chemical and seed companies, particularly agronomists and sales representatives, to increase the breadth and credibility of the Middle Deschutes PSP to the growers.	
		Metric 2: Meet with technical field staff from 2 companies to develop material, repeat as needed across the 5 years to maintain relevancy.
Goal 2: Develop communication material to increase understanding of Middle Deschutes PSP objectives and Integrative Pest Management		
	Strategy 1: Connect with chemical companies to work with technical staff to develop mutual knowledge on barriers, alternatives, and best management practices unique to the area.	
		Metric 1: Provide one news article and two newsletters per year, totaling 15 articles reaching 1,000 people per year. And develop material for best management practices for 6 target groups based on crops grown (bluegrass seed, carrot seed, and hay), irrigation practice applied (sprinkler, and furrow irrigation), or pesticide used (those listed as High Pesticides of Concern).
Goal 3: Develop a unifying campaign to reduce pesticides in the waterways		
	Strategy 1: Establish formalized partnership initiative (a shared vision) onto which partners can sign (non-profits, businesses, municipalities, private landowners, etc)	
		Metric 1: Sign 10 entities onto the formalized partnership initiative (a shared vision). Provide annual updates to formal partners through an annual meeting.
	Strategy 2: Develop new relationships with additional organizations, businesses, municipalities, and other potential partners as they arise.	
		Metric 2: Reach out to one new agency per quarter by attending an event, meeting, or connecting directly. Totaling 20 new relationship with local partners.
	Strategy 3: Work with partners to prioritize key outreach events to increase community awareness of Middle Deschutes PSP and its work.	
		Metric 3: Host, attend, table, or speak at 3 events per year. Totaling 15 events over the next 5 years.

The Middle Deschutes Watershed is predominantly rural among irrigated agricultural fields, growing crops such as alfalfa, hay, bluegrass seed or hybrid carrot seed. Due to the specialty of the crops grown (bluegrass and hybrid carrot seed) and subsequent limitation on pesticides allowed for these crops, outreach will emphasize preventing the transport of soil and water off the land into natural drainages, rather than only presenting alternative pesticides. Common water transport mechanisms include field runoff, irrigation tailwater, or precipitation events into the natural drainages. And examples of tools to reduce pesticide loading include reducing the volume of pesticides applied, hampering the movement of water or soil off treated lands, or creating a treatment buffer between the region of applied pesticides and the riparian zone. It is anticipated that substantial improvements in water quality are achievable by exploring these tools directly with pesticide users and land managers.

3.6.2 Pesticide Goals

Each goal has a strategy and metric to track its success. The communication goals focus on the number of people reached, the number of connections made to local groups, and the number of events in which the program was presented. The pesticide goals outlined in Table 8 set detection frequency and concentration goals for the POC and LPP (or any pesticide considered "high level of concern" based on the decision matrix). Goals 1, 2, and 3 are anticipated to be complete by the end of the five-year plan, while the mid-goal serves as a steppingstone along the way. Considering that the DEQ protocol to develop the POC rating considers the detection frequency and concentration of each pesticide, it can be expected that if either the frequency or concentration of a pesticide is reduced, so will the POC rating (Figure 25). Therefore, achieving Goals 1 and 2 will lead to achieving Goal 3.

Table 8. MDPSP Pesticide Goals for 2028

Goals for Measured Pesticide Concentrations Complete by December 31, 2028	
Goal 1: ***All measured Pesticides of Concern in 2028 (measured between January 1, 2028 and December 31, 2028) are below aquatic life benchmarks.***	
	Mid-Goal: Reduce the max aquatic life ratio (as of 2022) by 50% by the December 31, 2026. *Imidacloprid had the highest ALR of 12 in 2022. By 2026, it will not exceed 6 ALR and will continue to remain below 6 ALR through December 31, 2028*
Goal 2: ***Reduce detection frequency by 25% of the four highest detected pesticides of 2023 by December 31, 2028. Measured by comparing the detection frequency of the 2023 sampling year (based on the 2020-2022 data set) to the detection frequency of the 2029 sampling year (based on the 2026-2028 data set)*** *AMPA had a detection frequency of 73% in 2023, will be reduced to or below 48% by 2028.* *Glyphosate had a detection frequency of 51% in 2023, will be reduced to or below 26% in 2028.* *Diuron had a detection frequency of 53% in 2023, will be reduced to or below 28% by 2028.* *Linuron had a detection frequency of 43% in 2023, will be reduced to or below 18% by 2028.*	
Goal 3: ***Reduce the number of High Pesticides of Concerns by 4 by December 31, 2028. Measured by comparing the total number of High Pesticides of Concern in 2023 (2020-2022 data set), to the total number of High Pesticides of Concern in 2029 (2026-2028 data set)***	

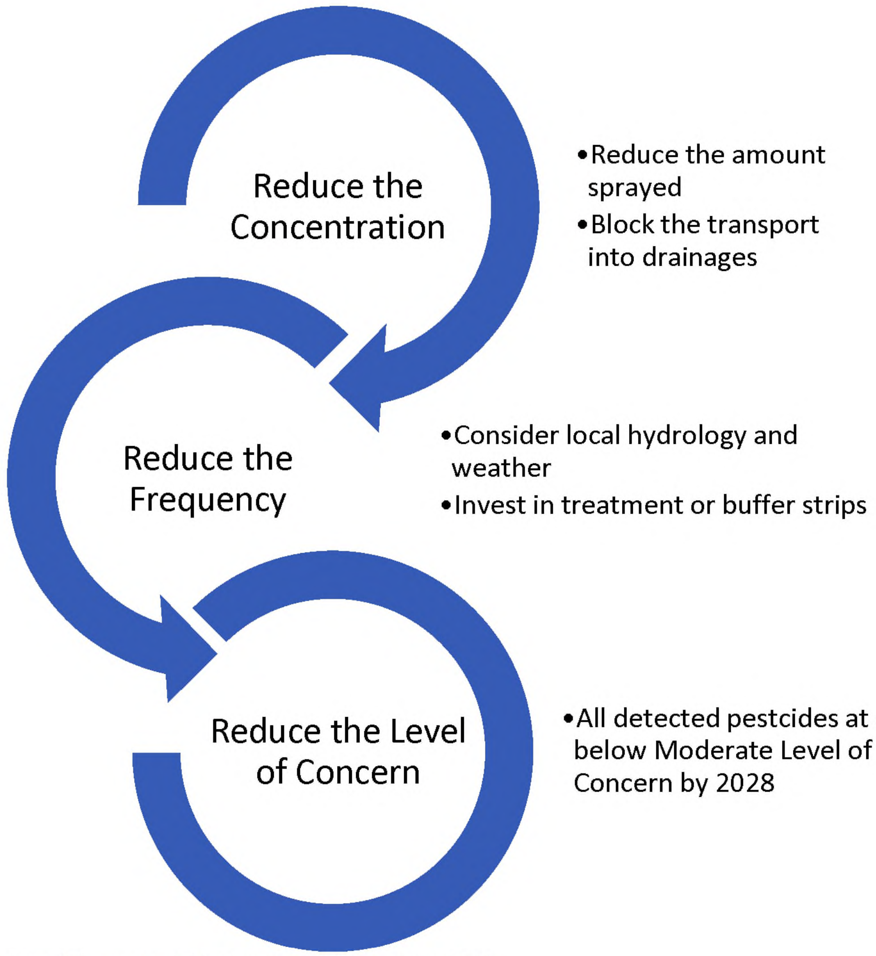

Figure 25. Approach and Theory to Achieving Pesticide Goals by 2028

3.7 Technical Assistance and Financial Needs

ODA provides grant funding through the Oregon PSP program for which established partnerships apply on a biennial basis. The MDPSP has received funding through this program since 2019 and has been awarded funds for the 2023-2025 biennium (Table 9). The SWCD will house and manage the grant funding needed to implement the Strategic Plan and will continue to apply for additional funding with each biennium. The grant funding provides for resources and staff time within the SWCD to implement outreach, collaborative problem-solving among technical assistance, and project management. The SWCD will lean on its technical assistance allies to magnify the impact and reach of the Strategic Plan throughout the community.

Table 9. MDPSP 2023-2025 Biennium Budget, Funded through the Oregon PSP Program.

MDPSP 2023-2025 Biennium Budget	
Program Administration and Overhead	$24,234
Monitoring	$6,050
Strategic Plan Implementation	$15,960
Total Funds Requested	**$46,244**

Technical assistance will be provided by local extension services, chemical and seed companies, and public municipalities to support the SWCD so that the MDPSP can be implemented with the best science, local resources, and a unified direction. These allies regularly work closely with the growers and advise them on pesticide usage and noxious weed management. Leaning on their expertise and knowledge of local challenges and interests ensure that the community-based solutions are sustainable. And because their time and funding are not tied to a two-year grant, the messages and lessons learned through the Strategic Plan will continue beyond the confines of the grant.

There is interest to expand the scope of the project by adding special projects related to integrative pest management (IPM) through the lens of drought. Drought has impacted the timing of pesticide usage, its effect on target pests, and the pest population distribution and dynamics. The MDPSP would benefit from real-time information sharing/gathering in conjunction with the proposed outreach to best serve this community as it faces novel and emerging challenges. The SWCD would provide outreach to growers through IPM workshops and seminars and create a space for real-time information sharing and peer-to-peer learning. And the SWCD would engage the public by developing surveys and case studies to learn from local challenges and successes in a way that best reaches our growers. And SWCD and its partners then would provide technical support in light of the greater impact of these conditions being new and not well understood. It is anticipated that this additional special project would cost $50,000-$80,000 per biennium in additional funding.

Section 4. Progress and Adaptive Management

This Strategic Plan provides the outline for the next five years; however, it is funded by and reported to ODA biannually. This allows for biennial reviews of the Plan, its funding, and its progress. The SWCD will lead the documentation, reporting, and reflection of the Strategic Plan and its results to all necessary parties. The Strategic Plan development was made possible through the invaluable efforts of the Advisory Council, who also serve as allies in the implementation of the plan. As outlined in the communication goals, the reporting and sharing of progress to the public is as important to the success of this plan as reporting to the Advisory Council and funders.

4.1 Documentation of Improvements

The SWCD will document and share the improvements made throughout the Strategic Plan to the public through diverse avenues. Recalling the metrics from the communication goals, Table 10 outlines the methods of documenting improvements in ways that are well distributed among the community. Through outreach, the SWCD will promote 15 articles, 6 pamphlets, establish 30 partnerships and local connections, and appear at 15 events. The rural community within the Management Area has many agricultural events, such as county fairs, agricultural fairs, town halls, town meetings, farmers markets, and special events related to water resources, soil health, irrigation systems, and more.

Table 10. Metrics from Communication Goals and Estimated Number of People Reached

Metrics from Communication Goals	Estimated Number of People Reached
Reach out to 3 local chemical companies to make contact and develop relationship.	15 staff, agronomists, sales associates
Meet with technical field staff from 2 companies to develop material, repeat as needed across the 5 years to maintain relevancy.	4 staff, agronomists, sales associates
Provide one news article and two newsletters per year, totaling 15 articles reaching 1,000 people per year. And develop material for best management practices for 6 target groups	3,000-5,000 general public, growers, and pesticide users
Sign 10 entities onto the formalized partnership initiative (a shared vision). Provide annual updates to formal partners through an annual meeting.	40 people
Reach out to one new agency per quarter by attending an event, meeting, or connecting directly. Totaling 20 new relationship with local partners	20 people
Host, attend, table, or speak at 3 events per year. Totaling 15 events over the next 5 years.	200 people

In addition to reaching the public, the MDPSP will record its progress in a biennial report provide to the Advisory Council, the WQPMT, ODA, and the SWCD Board of Directors. This report will be presented at the SWCD annual meeting, hosted at the Central Oregon Farm Fair each February, and will be available on the SWCD website for easy reference.

4.2 Biennial Reviews and Adaptive Management

Because the Strategic Plan will be implemented within a biennial funding schedule, the reviews and adaptations will follow a biennial schedule (Table 11). A concise, single-page annual report will be provided to the Advisory Council, which is composed of local stakeholders, technical assistance allies, and interested parties. Suggestions and adaptations will be compiled throughout each two-year funding cycle, and if approved by the Advisory Council, adaptations will be integrated into the funding application and plan for the next funding cycle. Adaptations will be made with the focus of improving water quality in the natural drainages and Middle Deschutes River.

Table 11. Reporting Schedule for the MDPSP Strategic Plan 2024-2029

Reporting Schedule	
Annual Report to Advisory Council	June 30, 2024
Biennial Report to ODA/ 2023-2025 Grant Cycle Completion Report	June 30, 2025
Annual Report to Advisory Council/ Strategic Plan Mid-Review	June 30, 2026
Biennial Report to ODA/ 2025-2027 Grant Cycle Completion Report	June 30, 2027
Annual Report to Advisory Council	June 30, 2028
FINAL Strategic Plan Completion Report/ 2027-2029 Grant Cycle Completion Report	June 30, 2029

The SWCD will schedule, coordinate, and record Advisory Council meetings. It is expected that the Advisory Council will meet annually or review the annual report. The Advisory Council will grow and evolve with the implementation of the Strategic Plan, but it will always include representatives from the SWCD, DEQ, ODA, OSU, and one local chemical company.

Table 12. MDPSP Strategic Plan Advisory Council

Name	Organization
Lisa Windom	Jefferson County Soil and Water Conservation District
David Gruen	Oregon Department of Environmental Quality
Kathryn Rifenburg	Oregon Department of Agriculture
John Spring	Oregon State University/Central Oregon Seed, Inc
Rob Galyen	Jefferson County Soil and Water Conservation District, Board of Directors
Albert Sikkens	Pratum Coop
Abigail Tomasek	Oregon State University
Manuel Garcia	Oregon State University
Amanda Ondrick	Oregon Department of Environmental Quality
Staci Merkt	Jefferson County Soil and Water Conservation District
Ally Steinmetz	Middle Deschutes Watershed Council
Ellen Hammond	Jefferson County Soil and Water Conservation District

References

Confederated Tribes of Warm Springs. (2021). *History*. Retrieved from Warmsprings-nsn.gov.

Environmental Protection Agency. (1995). *R.E.D. Facts: Linuron.* United States Environmental Protection Agency.

Jefferson County Soil and Water Conservation Distrct. (2022). *Agency Plains CIS Annual Report.*

Jefferson County Soil and Water Conservation Distrct. (2022). *Jefferson County Soil and Water Conservation District Annual Report.*

North Unit Irrigation District. (2019). *History*. Retrieved from Northunitid.com.

North Unit Irrigation District. (2022). *Crop Survey.*

North Unit Irrigation District. (2023, May). *Charges and Allotment History*. Retrieved from northunitid.com: www.northunitid.com/allotment-and-charges

Northwest Center for Alternatives to Pesticides. (2017). *Best Management Practices to Protect Water and Fish: Diuron.* Northwest Center for Alternatives to Pesticides.

Northwest Center for Alternatives to Pesticides. (2017). *Best Management Practices to Protect Water and Fish: Imidacloprid.* Northwest Center for Alternatives to Pesticides.

Oregon Department of Agriculture. (2020). *Middle Deschutes Agricultural Water Quality Management Plan.*

Oregon Department of Agriculture. (2023). *Pesticide Stewardship Partnership*. Retrieved from Oregon.gov.

Portland General Electric. (2020). *Our Story*. Retrieved from PortlandGeneral.com.

Reinholtz, A. L. (2021). *Amazon Creek Pesticide Stewardship Partnership Strategic Plan.*

Speece, J. G. (2019). *The Middle Rogue Pesticide Stewardship Partnership Strategic Plan.*

The Bend Bulletin. (2020). *The Great Railroad Race*. Retrieved from BendBulletin.com.

U.S. Fish and Wildlife Service. (2020). *Deschutes Basin Habitat Conservation Plan.*

United States Department of Agriculture. (2023). *WebSoilSurvey.NRCS.USDA.gov*. Retrieved from Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Appendix

MDPSP Pesticide of Concern (Low, Moderate, High) for 2020-2022, includes Culver Drain, Campbell Creek, and Mud Springs Creek.

Pesticide Name	Number of samples (n)	Number of Samples with pesticides detected	Detection Frequency	Number of detections over 50% of acute ALB	Number of detections over 50% of chronic ALB	Level of Concern	Data Years
Diuron	127	67	52.8	22	5	High	2020 - 2022
Linuron	127	54	42.5	27	27	High	2020 - 2022
Dimethenamid	127	26	20.5	1	0	High	2020 - 2022
Dimethoate	127	20	15.7	6	6	High	2020 - 2022
Oxyfluorfen	127	10	7.9	1	1	High	2020 - 2022
Metolachlor	127	8	6.3	1	0	High	2020 - 2022
Imidacloprid	127	7	5.5	0	7	High	2020 - 2022
(RS)-AMPA (Aminomethyl phosphonic acid)	118	86	72.9	0	0	Moderate	2020 - 2022
Glyphosate	123	63	51.2	0	0	Moderate	2020 - 2022
Azoxystrobin	127	42	33.1	0	0	Low	2020 - 2022
Prometryn	127	42	33.1	0	0	Low	2020 - 2022
Propiconazole	127	30	23.6	0	0	Low	2020 - 2022
2,4-D	119	20	16.8	0	0	Low	2020 - 2022
Terbacil	127	18	14.2	0	0	Low	2020 - 2022
Dicamba	127	11	8.7	0	0	Low	2020 - 2022
Metribuzin	127	10	7.9	0	0	Low	2020 - 2022
Prometon	127	9	7.1	0	0	Low	2020 - 2022
Sulfometuron methyl	127	8	6.3	0	0	Low	2020 - 2022
Chlorthal monoacid and diacid degradates	88	7	8.0	0	0	Low	2020 - 2022
DEET	127	5	3.9	0	0	Low	2020 - 2022
Pendimethalin	127	5	3.9	0	0	Low	2020 - 2022
Bromacil	127	4	3.1	0	0	Low	2020 - 2022
Chlorthal-dimethyl	127	3	2.4	0	0	Low	2020 - 2022
Hexazinone	127	3	2.4	0	0	Low	2020 - 2022
Metsulfuron-methyl	101	3	3.0	0	0	Low	2020 - 2022
2,4-DB	107	1	0.9	0	0	Low	2020 - 2022
Acephate	123	1	0.8	0	0	Low	2020 - 2022
Methomyl	127	1	0.8	0	0	Low	2020 - 2022