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Salt River Watershed, Level I Study

Prepared For

Wyoming Water Development Commission

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Executive Summary

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1.0 Introduction

In 2023, the Star Valley Conservation District (SVCD) requested funding from the Wyoming Water Development Commission (WWDC) for the completion of a watershed management plan for the Wyoming portion of the Salt River Watershed. The funding request was intended to complete a comprehensive watershed inventory that identified land-use and water-resource issues, and to develop a plan to address them. In April 2024, the WWDC entered into a contract, following a standardized selection process, with Y2 Consultants, LLC (Y2) and its subcontractors, Sunrise Engineering, LLC (Sunrise) and Engineering Associates (EA), to complete the Level I Watershed Study.

2.0 Background

The Salt River Watershed project area is located in western Wyoming and lies entirely within Lincoln County, encompassing a diverse landscape that stretches from the valley floor of Star Valley to the high-elevation peaks of the Salt River Range. The watershed covers approximately 890 square miles and is classified as a fourth-level Hydrologic Unit Code (HUC 17040105), representing the Wyoming portion of the larger Salt River Subbasin.

The watershed contains roughly 220 miles of streams, anchored by the 80-mile mainstem of the Salt River, which flows northward through Star Valley before joining the Snake River at Palisades Reservoir. This mainstem is fed by an extensive network of tributaries originating in both Wyoming's Salt River Range and Idaho's Caribou Range. Major tributaries include Jackknife Creek, Tincup Creek, Strawberry Creek, Willow Creek, Stump Creek, Swift Creek, Dry Creek, Cottonwood Creek, Spring Creek, and Crow Creek, along with numerous spring-fed channels that emerge from the valley bottom. These tributaries are sustained predominantly by snowmelt, groundwater discharge, and high-elevation precipitation, which shape the hydrologic regime throughout the basin.

Elevation across the watershed ranges from approximately 5,600 feet above mean sea level in the lower valley to over 10,800 feet along the Salt River Range, producing strong climatic gradients that influence snowpack accumulation, runoff timing, vegetation communities, and habitat diversity. High-elevation snowpack typically peaks in early April, serving as the watershed's dominant water source and driving spring runoff that sustains streamflow and groundwater recharge throughout the summer growing season.

As a whole, the Salt River Watershed represents a geologically complex, hydrologically dynamic, and biologically rich system that supports agriculture, fisheries, wildlife, and rural communities throughout Star Valley. Its scale, diversity, and importance to the regional water supply make it one of western Wyoming's most significant watershed systems.

3.0 Purpose and Objectives

The Salt River Watershed Level I Study was undertaken to assemble existing data, incorporate stakeholder and landowner input, and integrate field-verified inventory findings into a comprehensive watershed-scale planning document for the Wyoming portion of the Salt River Basin. The Study provides the first basin-wide synthesis of the watershed's physical, biological, and anthropogenic systems and evaluates geomorphic conditions through the Rosgen Level I stream classification framework.

This assessment identified key watershed issues, including erosion, localized flooding, impaired stream reaches, aging and undersized irrigation infrastructure, water-supply limitations, habitat constraints, and invasive species, that collectively affect watershed function and long-term resource sustainability. Guided by these findings, the Study produced a practical and economically feasible Watershed Management and Rehabilitation Plan that outlines a prioritized suite of fundable project opportunities. Each recommended project includes conceptual details, cost estimates, permitting considerations, and potential funding pathways to support implementation.

The Study also strengthened long-term planning capacity be enhancing the Star Valley Conservation District's GIS platform, providing a more robust spatial database for project tracking and future decision-making. In addition, the Plan was intentionally designed to align with eligibility criteria for the Wyoming Water Development Commission's Small Water Project Program (SWPP) to increase opportunities for technical and financial support. Public involvement, including scoping meetings, workshops, field tours, and extensive landowner site visits, was central to the process and ensured that the resulting Plan reflects local priorities and on-the-ground needs.

3.1 Primary Objectives of the Level I Study

- Integrate existing and newly collected watershed data into a cohesive planning framework.
- Conduct a field-verified inventory of physical, biological, and human systems to identify resource concerns.
- Evaluate geomorphic conditions using Rosgen Level I classification to identify unstable or impaired reaches.
- Identify and prioritize watershed issues affecting hydrology, habitat, water quality, and infrastructure.
- Develop a practical, fundable Watershed Management and Rehabilitation Plan with cost estimates and permitting needs.
- Enhance SVCD's GIS platform for long-term data management and project tracking.
- Support eligibility for WWDC's SWPP by aligning project opportunities with program criteria.
- Engage landowners, agencies, and stakeholders to ensure the Plan reflects community needs and priorities.

4.0 Watershed Characteristics

The Salt River Watershed encompasses a diverse set of physical, biological, and anthropogenic systems that interact to shape watershed conditions, function, and management needs. The Level I Study represents the first basin-wide integration of these systems for the Wyoming portion of the watershed and provides a foundation for understanding current conditions and future management priorities.

4.1 Physical Systems

The watershed spans approximately 890 square miles, ranging from high-elevation alpine terrain above 10,800 feet to valley bottoms near 5,600 feet. Climate is characterized by cold winters, short growing seasons, and snow-dominated hydrology, with winter accumulation and spring snowmelt driving the

timing and magnitude of streamflow. Snow water equivalent at high-elevation SNOTEL sites typically peaks in early April, with melt continuing into June and July depending on elevation.

Geologically, the watershed lies within the Wyoming Overthrust Belt and is shaped by complex thrust faulting and basin formation. The Salt River Range produces extensive colluvial and alluvial material contributing to valley-floor aquifers, while the active Star Valley Fault influences topography, sediment delivery, and hazards such as landslides and seismic risk. Surficial deposits include alluvium, glacial tills, alluvial fan complexes, and landslide debris, each influencing soil development, slope stability, and groundwater recharge.

Surface water is dominated by the 80-mile Salt River mainstem and its major tributaries, nearly all of which are perennial due to strong groundwater-surface water connectivity. Groundwater recharge varies widely, 0-1 inches annually in valley bottoms compared to 16-35 inches in the Salt River Range, underscoring the importance of mountain snowpack to baseflow and overall water supply.

4.2 Biological Systems

The watershed supports a mosaic of vegetation communities, including evergreen and mixed conifer forests, sagebrush shrublands, grasslands, irrigated hay meadows, and extensive riparian and wetland complexes. Wetlands and riparian areas are concentrated along the Salt River and its major tributaries, providing critical habitat, flood attenuation, water-quality filtration, and hydrologic storage.

Fisheries resources are regionally significant. The lower Salt River is designated a Blue Ribbon trout fishery, and numerous tributaries support Yellowstone cutthroat trout, Snake River cutthroat trout, mountain whitefish, and other native species. A single aquatic invasive species, the New Zealand mudsnail, has been documented in the watershed, highlighting the need for prevention and monitoring.

Wildlife use is extensive across the watershed. Elk, moose, and mule deer rely on the valley for year-round, winter, and migration habitat; critical migration routes and parturition areas intersect many riparian and upland environments. Federally listed species potentially occurring within the watershed include Canada lynx, grizzly bear, and yellow-billed cuckoo; whitebark pine occurs in high-elevation forests. Numerous sensitive plant species and priority bird species are also present.

4.3 Anthropogenic Systems

Human use in the watershed centers on agriculture, rural communities, transportation corridors, and recreational access. Valley bottoms are dominated by irrigated pasture and hay production, supported by an extensive network of ditches, diversions, pipelines, and springs, many of which require rehabilitation or modernization. Irrigation practices influence groundwater recharge, late-season baseflow, and water availability for ecological and agricultural uses.

Population centers, including Afton, Thayne, Star Valley Ranch, and Alpine, coexist with dispersed rural development, influencing land use, water demand, and stormwater and wastewater infrastructure needs. Public lands in the Salt River Range and adjacent mountains support grazing, recreation, and forest management, while county roads, culverts, and bridges contribute to localized flow constriction and increased flood vulnerability.

Water management is guided by state water rights administration, the Snake River Compact, and multiple regulatory programs addressing water quality, wetlands, and aquatic invasive species. Existing

impairments, such as E. coli in the Salt River and Stump Creek, and selenium in Crow Creek, reflect both natural processes and land-use influences.

5.0 Hydrology Model

An updated hydrologic model was developed for the Salt River Watershed using more than 50 years of USGS streamflow data, refined irrigated acreage totals of 34,257 acres, enhanced methods for estimating tributary flows, and updated year-type classification representing dry, average, and wet hydrologic conditions. The model simulates both physically available and adjusted surface water volumes across 34 hydrologic reaches, providing a comprehensive picture of water availability throughout the watershed. Key findings from the modeling effort show that no basin-wide irrigation shortages were identified under modeled dry-year conditions, though real-world shortages may still occur due to operational practices, diversion timing, or climatic variability. Annual adjusted outflows vary substantially by year type; for example, Reach 34 ranges from approximately 393,619 acre-feet in dry years to nearly 1.5 million acre-feet in wet years, illustrating the system's hydrologic sensitivity. The Wyoming Game and Fish Department's instream flow right of 221 cubic feet per second at Reach 27 was shown to influence upstream hydrology during dry periods, affecting water availability for both ecological and agricultural users. Overall, the hydrologic model significantly improves understanding of surface water availability, seasonal trends, and flow constraints, providing critical support for restoration planning, irrigation infrastructure improvements, and long-term watershed management.

6.0 Watershed Management Plan

The Watershed Management Plan provides a comprehensive framework for improving the ecological function, water reliability, and long-term resilience of the Salt River Watershed. Developed from extensive field assessments, stakeholder input, hydrologic modeling, and GIS analysis, the Plan identifies a diverse set of opportunities to enhance watershed health across irrigation systems, riparian corridors, upland water sources, stream channels, flood-prone areas, wildlife habitats, and public recreation sites. These opportunities reflect both the watershed's physical needs and the priorities expressed by landowners, agricultural operators, conservation partners, and agency stakeholders throughout the study process. The resulting portfolio of projects is designed to improve water distribution efficiency, stabilize degrading streambanks, protect sensitive habitats, reduce erosion and sedimentation, support wildlife movements, and address infrastructure vulnerabilities identified during the inventory phase.

Project selection was guided by multiple criteria, including ecological benefit, technical feasibility, landowner willingness, cost-effectiveness, regulatory considerations, and alignment with funding program eligibility requirements. The projects capture the range of resource concerns documented throughout the watershed, from unstable channel segments and irrigation inefficiencies to vulnerable upland water supplies and degraded public access points. This structured approach ensures that the recommended projects not only address current resource issues but also position the Star Valley Conservation District and local partners to leverage state, federal, and nonprofit funding opportunities. Additionally, the Plan emphasizes implementation strategies that balance watershed-wide priorities with site-specific needs, making it adaptable as conditions evolve or new data emerge.

The recommended project categories reflect the diverse challenges and opportunities across the watershed. Irrigation diversion upgrades aim to replace aging, undersized, or failing structures to improve flow control and reduce maintenance burdens. Pipeline improvements and ditch-to-pipe conversions are

proposed to reduce water loss, enhance conveyance efficiency, and improve delivery reliability for agricultural users. Spring and solar water-development projects help distribute livestock use more evenly, reduce pressure on sensitive riparian areas, and improve upland water availability. Channel stabilization and erosion protection projects address unstable reaches experiencing bank failure, incision, or sediment loading, helping restore natural channel function and protect adjacent lands and infrastructure. Aquatic habitat improvements and fish-passage projects focus on reconnecting fragmented stream systems, improving spawning and rearing habitat, and supporting native and sport fisheries. Fire suppression water infrastructure provides reliable water sources for emergency response, reducing wildfire vulnerability in high-risk areas. Finally, recreation access improvements along the Salt River enhance public use, safety, and site durability while reducing resource impacts associated with unmanaged access.

Each recommended project includes estimated construction costs, permitting requirements, and a detailed review of potential funding sources to support implementation. Potential funding partners include the Wyoming Water Development Commission (WWDC), the NRCS Environmental Quality Incentives Program (EQIP), the U.S. Fish and Wildlife Service (USFWS), the Wyoming Game and Fish Department (WGFD), Trout Unlimited (TU), the National Fish and Wildlife Foundation (NFWF), and the Bureau of Reclamation (BOR), among others. Identifying these funding pathways at the Level I stage enhances the likelihood of successful project delivery by ensuring that proposed actions align with partner objectives, program requirements, and available cost-share mechanisms. Taken together, the Watershed Management Plan provides a prioritized, fundable, and actionable roadmap for improving watershed health, water reliability, and ecological resilience across the Salt River watershed.

7.0 Conclusions and Recommendations

7.1 Conclusions

The Level I Study concludes that the Salt River Watershed supports a diverse and highly valuable set of agricultural, ecological, and community resources that depend on proactive, coordinated management to remain resilient over the long term. The comprehensive watershed inventory revealed multiple areas where natural systems are under stress and where strategic investment will be critical to sustaining watershed function. Several stream reaches exhibit channel instability, incision, and loss of floodplain connectivity, conditions that can accelerate erosion, degrade habitat, and reduce the watershed's capacity to absorb peak flows. Water-quality impairments were also documented, most notably E. coli in segments of the Salt River and Stump Creek and selenium in reaches of Crow Creek, indicating that both point and non-point sources continue to affect beneficial uses. In addition, the watershed faces a high wildfire risk, as recent burns such as the Willow Creek Fire pose significant post-fire threats, including sediment loading, debris mobilization, and impacts on infrastructure and water supply reliability.

Aging infrastructure and inconsistent or limited diversion measurement present further challenges, reducing water-delivery efficiency and complicating planning efforts for both agricultural and ecological water needs. At the same time, the Study identified meaningful opportunities to enhance stream health, riparian function, aquatic habitat, and fish passage, restore degraded floodplain areas, and improve long-term water availability. Taken together, these findings illustrate the interconnected nature of hydrology, land use, habitat conditions, and infrastructure needs throughout the watershed. The data strongly support a cohesive watershed-wide vision that integrates scientific assessment, hydrologic modeling, landowner priorities, and funding opportunities to guide the practical, phased implementation of improvement projects across the Salt River watershed.

7.1.1 Projects

The Study recommends advancing more than twenty high-priority watershed improvement projects across the Salt River Watershed. These projects address the full spectrum of resource concerns identified during the Level I assessment and were selected for their technical feasibility, ecological value, and alignment with potential funding programs. Together, they represent over $11.3 million in proposed investment and are eligible for multi-agency support. Key project groups and examples include:

Irrigation Infrastructure Replacement Projects

These projects focus on replacing aging, undersized, or failing diversion structures to improve water delivery, reduce maintenance needs, and protect adjacent streambanks and habitat.

- East Side Canal Diversion Replacement – modernization of a critical diversion structure to improve flow regulation and operational reliability.
- Willow Creek Spillover Diversion Headgate Replacement – replacement of deteriorated structures to support stable diversions and reduce bank erosion.
- A-Frame Diversion Headgate Replacement – upgrades to improve water conveyance and reduce sedimentation issues.
- Stump Creek Diversion Replacement – replacement of failing diversion infrastructure to enhance irrigation efficiency and channel stability.

Pipeline Improvement & Ditch-to-Pipe Conversion Projects

These projects aim to reduce seepage-related water loss, increase conveyance efficiency, and protect water quality by converting open ditches to closed systems or upgrading existing pipelines.

- West Cedar Creek Pipeline Improvements – installation of new pipeline sections to improve capacity and reduce conveyance losses.
- Miller Transmission Main Pipeline Improvements – major upgrades to aging pipeline infrastructure serving multiple irrigators.
- Upper Strawberry Transmission Main Improvements – replacements and capacity improvements for high-elevation irrigation pipelines.
- Star Valley Ranch Pipeline Conversion – conversion of open ditch sections to pipeline to reduce water loss and improve system reliability.

Culvert & Fish Passage Enhancement Projects

These projects remove fish barriers, improve passage for aquatic organisms, and reduce localized flooding and sedimentation.

- Craney Creek Culvert Replacement – installation of a properly sized, fish-friendly crossing to improve hydrologic connectivity and reduce road-related erosion.

Environmental Restoration & Channel Stabilization Projects

These projects restore degraded stream reaches, stabilize eroding banks, improve hydraulic function, and protect adjacent infrastructure.

- Stewart Creek Channel Stabilization – implementation of bank stabilization and grade-control measures to reduce erosion.
- Prater Canyon Erosion Protection – repair of severe erosion along roadway corridors and drainage channels.

- Nield Livestock River Channel Restoration – restoration of riparian areas affected by livestock impacts to improve habitat and water quality.
- West Fork Salt River Bank Stabilization – large-scale stabilization of eroding banks to protect land, habitat, and water quality.

Fire Suppression Water Infrastructure Projects

These projects improve emergency water availability and enhance wildfire-response capacity across high-risk areas of the watershed.

- Star Valley Ranch Draft Station – installation of a dedicated drafting point to support raid and reliable wildfire suppression efforts.
- Alpine Village Draft Station Retrofit – upgrades to improve the reliability, accessibility, and performance of emergency water drafting infrastructure.
- Granite Ridge Draft Station Retrofit – modifications to enhance fire-response capability within a high-risk wildland-urban interface area.

Livestock Watering & Upland Water Supply Projects

These projects distribute livestock use more evenly across landscapes and reduce pressure on riparian corridors.

- Solar Water Development Systems – installation of solar-powered pumps and troughs to move livestock away from sensitive streambanks.
- Spring Reconstruction Projects – redevelopment of natural springs to improve reliability and protect water sources from degradation.

Recreation Access & Public Use Improvements

These projects enhance recreational safety, reduce resource damage, and improve site functionality across heavily used public access areas.

- Salt River Public Access Area Improvements (9 Sites) – upgrades such as improved parking, bank stabilization, boat-launch improvements, erosion control, and ADA-accessible features to support fishing, boating, and general recreation.

7.2 Recommendations

Based on the findings of the Level I Watershed Study, a coordinated and phased approach to watershed improvement is recommended. The following actions are drawn from recommendations embedded throughout the report, including hydrology, geomorphology, water quality, habitat, irrigation infrastructure, wildfire risk, GIS development, permitting considerations, and funding strategy. Taken together, these recommendations provide a practical roadmap for improving watershed resilience, protecting natural resources, and supporting long-term community and agricultural needs.

7.2.1 Funding & Project Implementation

- Capitalize on the SWPP eligibility of irrigation rehabilitation and livestock/wildlife watering projects for near-term implementation.
- It is recommended that the larger projects provided in the Watershed Management and Rehabilitation Plan be split into phases to allow funding sources to be used more effectively. For example, the pipeline projects could be split into smaller segments, or improvements at different levels could occur at different times with varying sources of funding.

- Promote SWPP benefits (direct improvements, watershed plan awareness) via SVCD communication channels.
- Encourage landowners and managers to consult with the SVCD (eligible SWPP sponsor) and NRCS for design and guidance.

7.2.2 Leverage Multi-Source Funding & Partnerships

- Explore funding opportunities, combining SWPP with resources from WGFD, TU, and other sources to address multiple benefits (e.g., fish passage and irrigation upgrades).
- Recommend the continued partnership between SVCD and TU. Leverage the RCPP funding that was awarded in 2025 for watershed projects listed in the Watershed Management and Rehabilitation Plan, and for future watershed projects that come up.
- Investigate innovative financing strategies for local, collaborative projects addressing multiple watershed issues.

7.2.3 Use & Maintain Existing Analytical Tools

- Utilize the project GIS and digital library as tools for planning and development.
- Maintain the SVCD standalone GIS platform using the Lincoln County GIS platform to provide watershed information to landowners to assist in planning future potential watershed projects.
- Update resources as information changes. Recommend updating information on the County GIS platform every 2-3 years.

7.2.4 Promote Community Involvement in Stream Restoration

- Foster community-sponsored stream channel and habitat improvement projects (e.g., bank stabilization using willow plantings) for their direct and ancillary benefits.

7.2.5 Maintain Communication & Outreach

- Continue communication between the SVCD and stakeholders regarding irrigation system improvements.
- Recommend that SVCD continue its annual meeting with Lincoln County Weed and Pest to discuss watershed projects and discuss potential future projects.
- Recommend that SVCD hold an annual meeting with all the irrigation districts in the watershed to discuss future projects and priorities for the irrigation districts.
- Partner with the Salt River Watershed Group (led by Trout Unlimited) to communicate the SWPP and discuss upcoming and potential watershed projects.

7.2.6 Facilitate Application for all Interested Parties

- Assure new individuals or parties who express interest after the Study that they remain eligible for SWPP, even if they have not met with the Study's project team.

7.2.7 Pond Inventory Assessment & Enhancement

- Develop a centralized database of all ponds within the watershed. This inventory should include location, size, ownership, and primary uses (e.g., irrigation, livestock, recreation, wildlife habitat).
- Conduct periodic evaluations of pond health, including water quality, structural integrity, sedimentation levels, and surrounding land use impacts. Review current management practices to identify areas for improvement in nutrient control, erosion prevention, and habitat enhancement.

- Utilize high-resolution GIS (EagleView Pictometry), remote sensing technologies, and ground truthing to create accurate maps of pond boundaries. This will support better planning, monitoring, and compliance with any future regulatory requirements.
- Establish a refined, detailed record of all permits associated with existing ponds, including construction, modification, and water rights. This log will improve transparency, facilitate regulatory compliance, and streamline future permitting processes.
- Recommend initiating discussions with Lincoln County Commissioners and the Planning Department to explore the development and implementation of regulations governing pond construction and management.