TECHNICAL MEMORANDUM FROM

P. O. Box 8578, 140 E. Broadway, Suite 23, Jackson, Wyoming 83002; voice: (307) 733-4216 • fax: (307) 733-1245

To: **Briana Swette, Pale Gem, LLC**

Date: **June 24, 2022**

Re: **Big Wood River Restoration, Pale Gem LLC Project**

The content of this technical memorandum outlines the findings and recommendations made by Biota Research and Consulting, Inc. (Biota) regarding site assessment, analyses, and development of conceptual design plans for a bank restoration plan for the Big Wood River in the vicinity of the Pale Gem LLC property (RP01N18001038A) south of Bellevue, ID (Sheets 1 and 4 of the design drawings). Project treatments would occur entirely on the Pale Gem, LLC Property. Landowners within 300 feet (ft) upstream and 1,000 ft downstream from the proposed project area are shown on Sheet 3.

The project is intended to stabilize the channel banks and improve fish habitat conditions by utilizing bioengineered bank restoration techniques. The following project objectives were identified based upon existing site conditions, land use constraints, and restoration potential.

1. Stabilize the river bank with revegetation and bioengineering techniques
2. Repair a damaged rock barb structure
3. Implement treatments that reduce, or leave unaltered, the flood hazard proximate to development
4. Identify self-maintaining treatments that maximize the ecological values of the Big Wood River

The primary strategy to meet project objectives is to restore bank stability through application of established river restoration techniques and revegetation strategies.

1.0 SITE ASSESSMENT

The site assessment for this project was informed by field survey data collection, field observations, data analyses, local hydrologic and topographic data (including LiDAR flown in the fall of 2017 by Quantum Spatial Inc.).

There has been severe lateral channel migration through bank erosion in the project area in recent years. A review of aerial photography indicates that there has been over 200 ft of lateral channel migration since 2016, the majority of which occurred during the flood of 2017 (Figures 1 and 2). The resulting geomorphic conditions in the project area can be described as highly unstable with an expansive braided channel form. The width of the active channel area is approximately 850 ft in the project area. Note the extensive loss of riparian vegetation in Figure 2. Currently, the main flow path is along the western side of the channel for most of the Pale Gem LLC property crossing over to the eastern edge directing flows towards a failing rock barb structure near the southern end of the property. Two large mid-channel log jams that formed

during the 2017 flood event create a dispersed network of low flow channels near this location. Photographs depicting project area existing site conditions are provided in Figures 3 to 8.

Figure 1. Aerial imagery from July 2016 depicting channel conditions in the project area (Source: Google Earth).

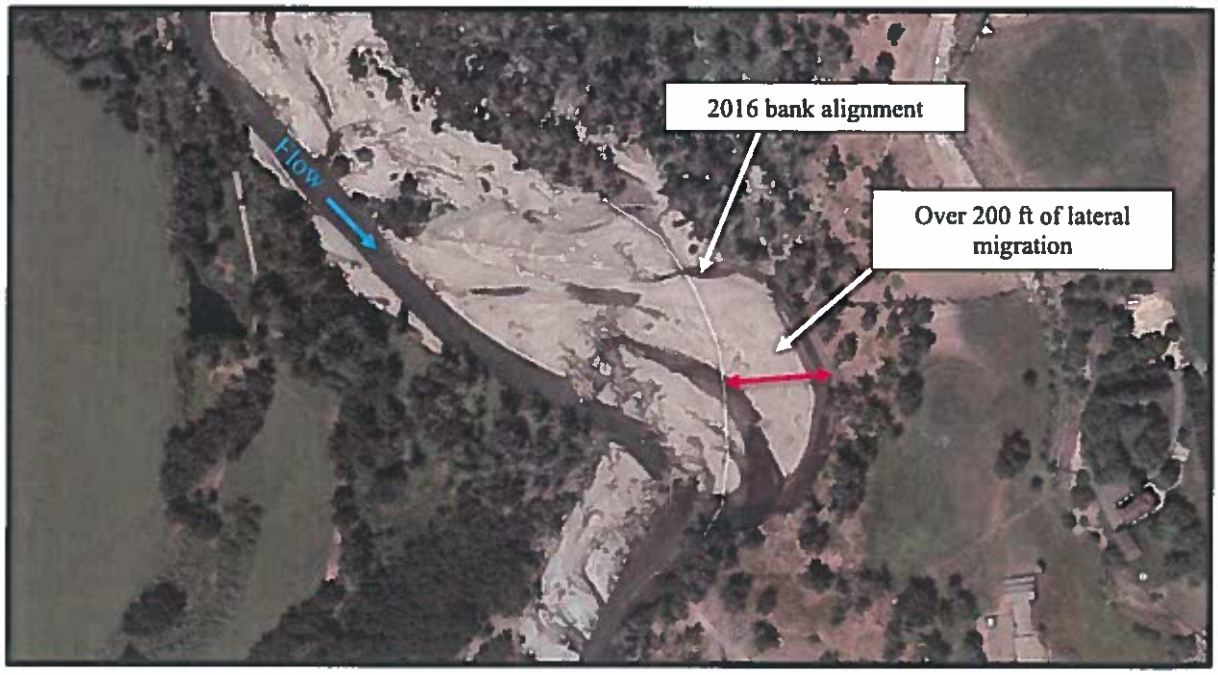

Figure 2. Aerial imagery from July 2017 lateral channel migration and log jam formation (Source: Google Earth).

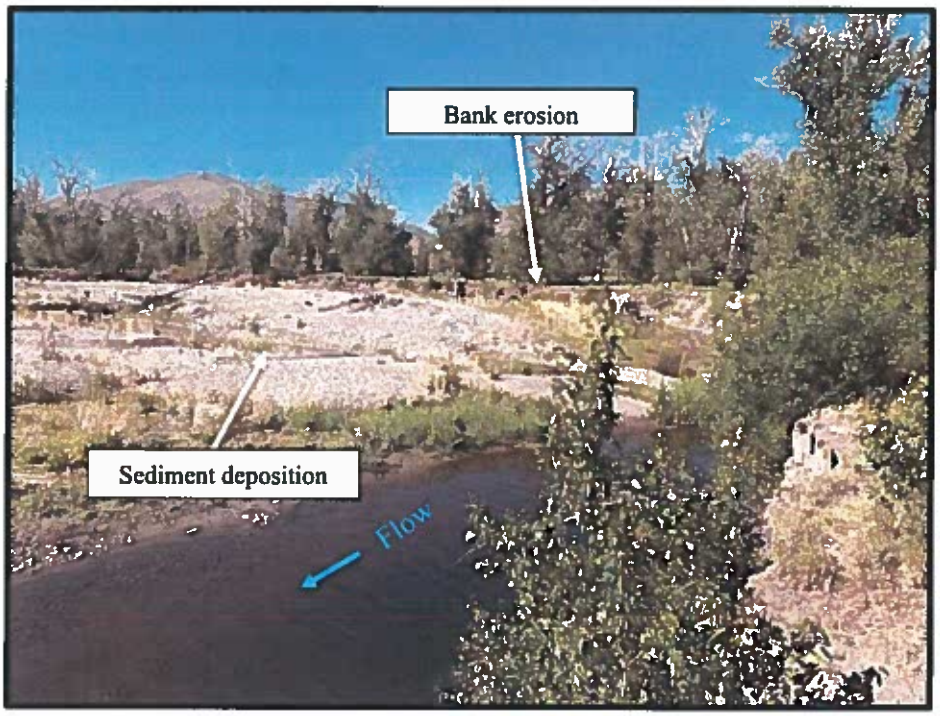

Figure 3. Photograph depicting bank erosion in the project area (view from the south)

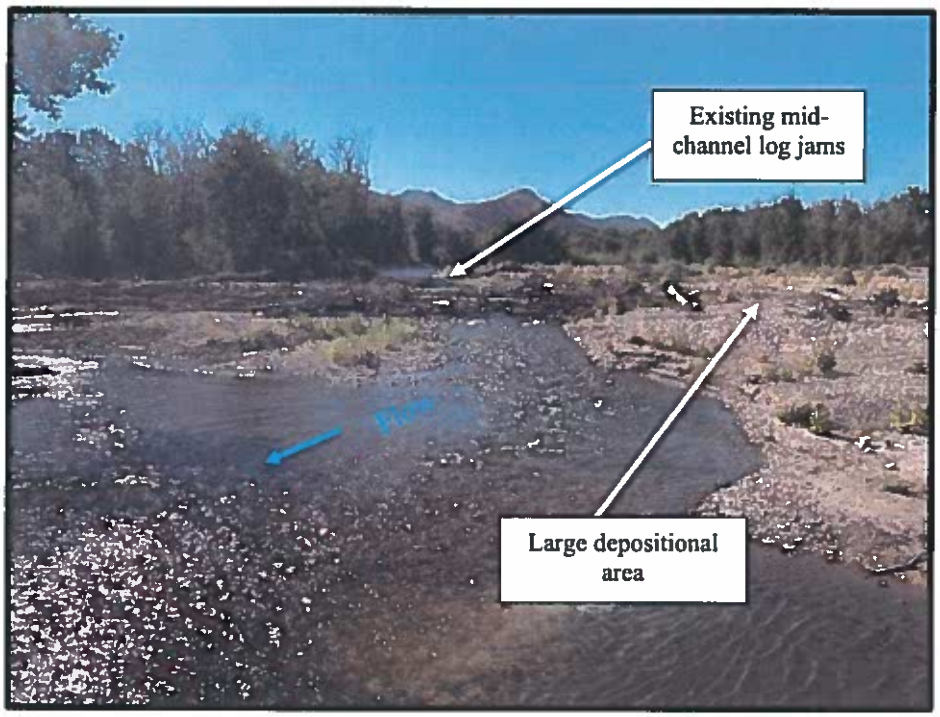

Figure 4. Photograph depicting existing log jams and channel conditions in the project area (view from the southeast)

Figure 5. Photograph depicting large mid-channel log jams in the project area (view from the north).

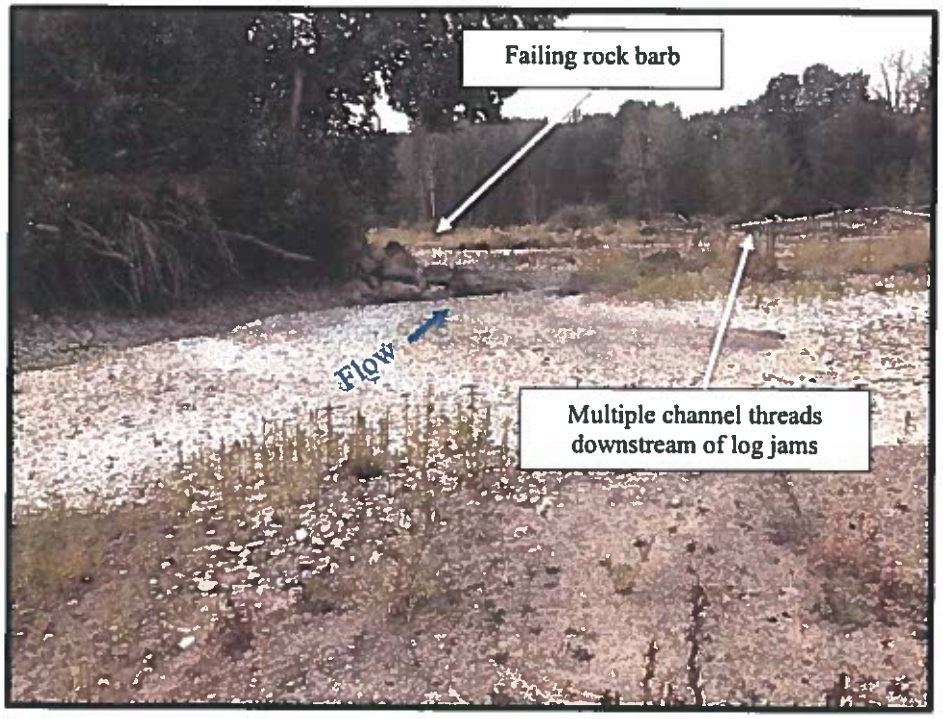

Figure 6. Photograph depicting a failing rock barb near the downstream end of the project area (view from the northeast).

Figure 7. Photograph depicting vegetation establishment along the bank toe (view from the south).

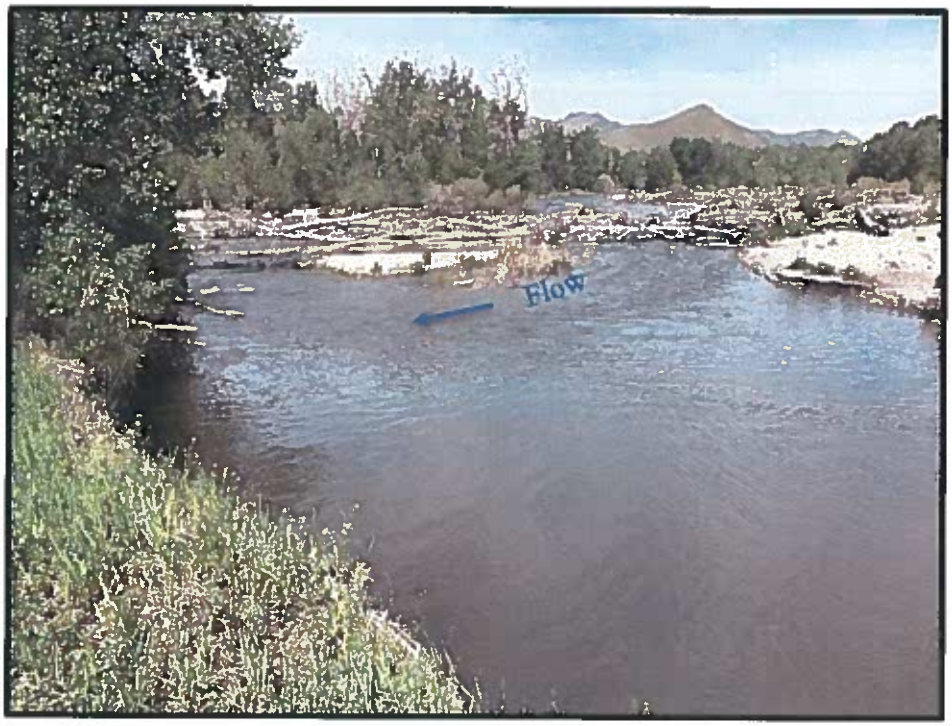

Figure 8. Photograph depicting high bank erosion hazard area with impinging flows (view from the southeast).

2.0 RESTORATION DESIGN PLANS

The proposed restoration design plan for the project is to increase the stability of the river bank on the Pale Jem LLC property with restoration treatments incorporating revegetation, bioengineering, bank grading, and large wood structures. The project design plan also includes treatments to repair a failing rock barb structure, including scour protection, and construct a rock toe in the area with increased bank erosion risk. Revegetation would occur along the toe of the bank and in the river adjacent to the bank to add roughness and promote increased stability. Bank grading would occur in specific areas where the current near vertical bank slope is a safety concern for the landowner with minimal impact to mature overstory vegetation.

Several other alternatives were considered but eliminated in the design development process. Treatments to modify the alignment of the main channel flow path were considered but eliminated due to the highly dynamic nature of the project reach and the over-widened braided channel form. Because of these factors, it was determined that treatments to modify the main channel alignment would have a low probability of success. An alternative was considered to regrade the channel banks throughout the length of the property, but that alternative would result in the removal of recent (since 2017) willow growth that is helping to stabilize the bank so that alternative was also eliminated. An alternative suggested by Blaine County staff was also considered. That alternative included excavating the area behind the rock groin structure in order to have a more gradual bank alignment. This alternative would involve the removal of a mature stand of cottonwoods. The alternative was eliminated because it would increase the bank erosion risk to the downstream landowner and therefore could not be completed without the potential for adverse impacts downstream.

2.1 DESIGN CRITERIA

The design development process included engineering analyses to evaluate the performance and stability of proposed project area treatments. The project design plan set includes design drawings, estimated construction quantities, and technical specifications. The design criteria for the design of the channel rock toe and large wood included the following:

1. Scour protection for the 100-year flow event scour
2. Structure stability for the 100-year flow event
3. Hydraulic modeling based on proposed site conditions to confirm no adverse impact finding

For design purposes, a two-dimensional (2D) hydraulic model was developed using the US Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS) software. The 2021 topographic survey data and the 2017 LiDAR were used for the basis of the model development. Land use types were delineated based on site observations and hydraulic roughness values were assigned based on best engineer judgement. A separate one-dimensional (1D) hydraulic modeling effort and a no adverse impact evaluation was developed prior for project permitting. A no-rise evaluation was not needed because work is not proposed within the floodway except to repair the rock barb. The repair does not propose additional rock fill above the channel bed elevation. Scour protection will be installed below the existing channel bed but this doesn't impact the base flood water surface.

The peak flow record for the (USGS) Hailey gage was analyzed using current Extreme Moments Algorithm (EMA) methods. The design flows were translated to the project site based on the ratio of drainage area following the methods provided in Wood et al. (2016). The 100-year recurrence interval event for the site was estimated at 8,379 cubic feet per second (cfs). This flow was used in the steady-

state 2D hydraulic model to evaluate current and proposed conditions for depth, velocity and shear stress. In addition, an estimated bankfull flow at the USGS gage of 1,300 cfs was translated to the project site to identify a local bankfull flow of approximately 1,202 cfs.

2.3 BANK TREATMENTS

The proposed bank restoration length is approximately 650 lineal ft (Sheet 5). The majority of the bank restoration would be completed by installing willow cuttings along the toe to bankfull elevation of the bank. The cuttings would be installed by hand with a water-jet stinger to minimize impacts to the bank and existing vegetation growth. The willow cuttings would be installed butt end down to a depth of 1 ft below the lowest water table of the year and protrude 12 to 18 inches above the existing bank grades (Sheet 8). Willow cuttings would be placed at a 2 lineal ft spacing along the channel banks. This treatment is designed to maximize shade and cover with dense woody vegetation components. The treatment in these areas would not include significant bank grading to limit the disturbance of existing willow growth. Isolated areas may have the upper bank sod mat rolled over with an excavator bucket to increase stability and reduce hazards. An access ramp is included in the proposed restoration design to increase the safety of the project site and provide river access from the high terrace (Sheet 5).

Large wood structures are incorporated into the bank restoration treatments because the presence of large wood positively influences both physical and biological processes. Large wood serves many functions including increased erosion resistance, improved aquatic and riparian habitat, and reduced near bank shear stress and erosive energy. The proposed deflector jam structures (Sheets 5 and 6) are intended to shift the higher velocity and shear flow away from the bank. The orientation of structure logs is intended to replicate patterns typically observed in naturally occurring river bank log jams. The bank deflector jam structure incorporates a footer log, key logs with root wads, and pinning logs. The structure logs are also buried into the channel banks with the pinning logs and ballast boulders added for increased stability. Deflector (or barb) jams are a flow direction treatment technique described in the Big Wood River Atlas (Cardno 2020).

The proposed deflector log jam structures were evaluated for stability and scour. The scour evaluation included general bed scour in addition to local scour developed by the proposed jam configurations. The rock toe treatment for the high bank erosion hazard area, shown on Sheet 5 and 7, was designed, and material sized using U.S. Army Corps of Engineers technical bulletins and methodologies that incorporated input parameters of design channel geometry, channel slope, mean and maximum channel depths, flow velocity, and radius of curvature. The rock toe should extend from the bankfull elevation down to the local scour depth of 6 ft below the channel invert elevation, based on potential scour calculations. The rock toe should have a horizontal to vertical slope of 2H:1V with willow cutting bundles installed following the revegetation methods identified on Sheet 8 and described below. The rock toe treatment would tie into the repair of the failing barb at the downstream end of the treatment area. The rock barb repair would include placing scour protection rock to below the calculated potential scour depth to reduce the risk of future erosion and structure damage.

2.4 BAR REVEGETATION

The revegetation plan for the bar area, shown on Sheet 5 of the design plans includes the installation of dormant hardwood cuttings in brush trenches. The brush trenches are intended to promote the formation of a vegetated floodplain in this area. The brush trenches serve the purpose of reducing the velocity and

scour potential for floodplain flows and promoting fine sediment deposition. The bar revegetation treatment details are included on Sheet 8 of the design drawings.

2.5 SEEDING

A native upland seed mix (Sheet 9) would be dispersed throughout all disturbed areas, including all temporary haul roads and equipment and material storage areas.

A transitional specific seed mix (Sheet 9) would be disbursed in the bar revegetation area and along the revegetated channel banks. The seed mix would be applied to the upper bank of the bank grading and access grading areas. The proposed grading would include a 4-inch thick layer of topsoil to augment the existing soil and improve seed germination. The seed mix should be applied at the specified rate (pounds of pure live seed per acre).

3.0 SUMMARY AND CONCLUSIONS

The proposed bank restoration treatments would reduce the threat of future land loss and increased sediment inputs while providing habitat improvements. The design plan was developed to achieve objectives of increased bank stability while improving aquatic and riparian habitat conditions. The project design treatments, materials quantities, and design specifications are included in the design plans.

Project implementation would occur in an environmentally sensitive manner, and any incidental damage to the site would be reclaimed. Construction activities would be performed by an experienced contractor under the supervision and direction of the design consultant. Every reasonable effort would be made to complete the proposed enhancement design plans in a manner that minimizes the potential for adverse impacts to water quality, fish, wildlife, and the environment. Construction activities would comply with all permit conditions and be conducted using industry standard Best Management Practices (BMPs).

REFERENCES CITED

Cardno and Ecosystem Sciences, 2020. Big Wood River Atlas. Prepared for Blaine County, Idaho.

Wood, M.S., Fosness, R.L., Skinner, K.D., and Veilleux, A.G. 2016. Estimating peak-flow frequency statistics for selected gaged and ungaged sites in naturally flowing streams and rivers in Idaho (ver. 1.1, April 2017): U.S. Geological Survey Scientific Investigations Report 2016–5083, 56 p., https://doi.org/10.3133/sir20165083.