Subject: Replies to AECOM's responses to CNHP's review of Potential Impacts of the Nestle Project to Natural Resources in the Area.

March 2nd, 2009

Mr. Don Reimer
Chaffee County Director of Development Services
P.O. Box 699
Salida, CO 81201

Dear Don,
In my review of the NWNA project proposal of utmost consideration was my responsibility to Chaffee County. As an ecologist I believe that a comprehensive assessment of impacts requires taking a systems approach to evaluating any proposed development. Thus in my view, any proposal for re-allocation of water resources requires consideration of all factors that may impact the resource including climate, which is a major driving factor in aquatic systems, and wetland and riparian habitats, which are dependent on sufficient water for an appropriate period of time.

Chaffee County's 1041 permit requirements, with regard to natural resources, require characterization of wetland habitat and wildlife including species composition. The regulations also require a description "of the impacts and net effect that the proposed Activity would have on the floodplains, wetlands, and riparian areas" (9-302 (2)(b)). In my view, as described in the following reply to AECOM's comments, these 1041 requirements have not been met.

In the following sections the original review has been italicized, AECOM's comments are in red and my replies are in blue.

Thank you for the opportunity to review the NWNA proposal and to work with Chaffee County. As always, best regards!

Delia G. Malone
Ecologist
Colorado Natural Heritage Program

Subject: AECOM's Responses to Comments Made in CNHP's Draft Comments January 29, 2009
Dear Mr. Reimer:
Nestlé Waters North America, Inc. (NWNA) appreciates the opportunity to respond to CNHP's draft comments on our proposed spring development project in Chaffee County prior to submittal of final comments on our 1041 permit application. The responses provided below in red text were drafted at the request of NWNA by AECOM Environment (AECOM), the consultant who prepared the portions of the 1041 permit application pertinent to the CNHP comments. AECOM's responses are intended to clarify and correct a number of opinions and conclusions drawn by CNHP that are not supported by the substantial body of objective data collected by AECOM for NWNA over the past 18 months. This data and the associated analyses clearly support the findings and conclusions presented in the 1041 permit application submitted to Chaffee County. The Ruby Mountain and Bighorn Springs sites continue to be evaluated to determine the optimal use of the facilities to provide the requested withdrawal while having minimal impact to wetlands, habitat, and ongoing uses of those features. It is anticipated that the majority of withdrawals will come from sources at the Ruby Mountain site, which currently serves as a trout hatchery. The largest portion of the combined spring-water discharge passes through the Ruby Mountain site, where alterations to existing channels and engineered structures relating to the hatchery currently limit both the areal extent of the wetlands as well as their functions and values. A restoration plan has been developed for the property which will greatly improve the functions and values of the springs and associated riparian and wetland environments as well as its aesthetic appeal along the adjacent recreational corridor of the Arkansas River. A relatively small overall proportion of

the withdrawal may be derived from sources at the Bighorn Springs site, which has not been significantly altered from its natural state, with the exception of heavy livestock grazing in several nearby wetlands. The project may have an influence upon several of those low-quality wetlands, which would become subject to protection mechanisms that may help to reverse the adverse impacts caused by ongoing grazing practices. Higher quality wetlands in the vicinity of the project are not anticipated to respond significantly to those proposed withdrawals. A monitoring network is being established along with the Colorado Division of Wildlife (CDOW) to monitor for such a response, and establish a baseline for evaluating for potential detrimental impacts. The operation of that network will include both quantitative observations (areal extent of mapped wetlands, water-level data from wetland piezometers, and the rate of ground-water discharging from the springs along the channel draining Bighorn Springs) as well as qualitative evaluations regarding the functions and values of those wetlands. The requested withdrawal represents a relatively small proportion of the combined spring discharge at the two facilities. Through monitoring and source management practices, NWNA should be able to withdraw the requested withdrawal without causing significant adverse impacts to all existing uses of the associated features. Through restoration and rehabilitation of those features that are severely altered and limited by current management practices, the goal of NWNA is to actually achieve a positive net environmental and aesthetic impact at the sites. Although one of the two primary stated objectives of this assessment is to determine "whether or not the analysis and report fully addresses [sic] the requirements in Chaffee County's 1041 Regulations," CNHP renders no opinion on this matter. AECOM believes that the documentation submitted in support of NWNA's 1041 permit application adequately addresses the requirements established by Chaffee County regulations. In the next section, AECOM copied the CNHP comments and italicized them. AECOM's responses are in red text.

Nestle Project Application Review: Potential Impacts of the Nestle Project to Natural Resources in the Area

Delia G. Malone, Ecologist
Colorado Natural Heritage Program
Warner College of Natural Resources
Colorado State University
January 29th, 2009

I accepted the task to assess validity of the analysis given in the Nestle Water North America (NWNA) report and whether or not the analysis and report fully addresses the requirements in Chaffee County's 1041 Regulations.

I. Summary of Comments

A. This report is based on the results of the analysis presented by the applicant. The hydrological review and methodology are being completed by others. If the hydrology review results in a change to the data, this report may require revision. When the withdrawal project is viewed in the context of the entire hydrogeological system including the impacts of a changing climate, NWNA's conclusions, regarding sustainability of the proposed pumping rates and no negative impact to the aquifer, springs or stream flows and associated wetland vegetation, may not be supported.

In the Summary of Comments section presented on page 1, CNHP states that NWNA's consultant may be in err with regard to concluding that the proposed withdrawal is sustainable on a long-term basis and will not result in significant adverse impacts to the aquifer, stream flows, and wetland vegetation; no supporting evidence is cited to support this statement or otherwise refute the conclusions reached by AECOM and therefore AECOM stands by its original hydrogeological evaluation. Moreover, NWNA will propose a rigorous long-term wetlands monitoring program to ensure that any adverse impacts to on-site wetlands that are attributable to groundwater withdrawals from spring-water production boreholes are identified, documented, and remediated. The wetlands monitoring program, which will be conducted in consultation with the Colorado Department of Wildlife (CDOW), constitutes a major component of the best resource management practices for the Ruby Mountain and Bighorn sites.

The above referenced summary comments are supported in the body of the text. With regard to the monitoring that NWNA "will propose"; in the original submittal a long-term monitoring plan was mentioned but detail and protocols were not included. In a meeting with Dan Gregory of ENSR on February 27th he stated that they were in the process of "developing a wetland monitoring plan". This wetland monitoring plan will apparently be based on USACE guidelines. These guidelines are meant to provide non-botanists with the tools to delineate jurisdictional wetlands – they do not provide for a detailed wetland assessment and as such are insufficient as the basis for a monitoring plan.

B. Terrestrial and aquatic animals and habitat: NWNA conclusions, regarding no impact to wildlife and their habitat are not supported by the evidence. NWNA data has not considered the entire documented native wildlife community. Although Colorado Division Of Wildlife's (CDOW) analysis regarding no impact to elk, mule deer, bighorn and non-game mammal species are supported by existing data, other wildlife species documented to occur in the area were not included in the report. Several State Listed Bird Species of Concern have been recently reported in nearby, comparable habitat and could potentially use the Site area for breeding or foraging habitat, were not considered in the NWNA proposal. Wetland habitats in arid ecosystems are especially critical to both upland and wetland wildlife species and wetland alteration or loss could impact species' survivability.

The 1041 application states "low or little impact to wildlife and their habitat", rather than no impact. The 1041 permit application presented an array of species that may be found within the Project Area including big game, small game, furbearers, migratory birds, reptiles, amphibians, fish, and invertebrates. The state-listed species list was reviewed and appropriate species were included based on habitat associations and occurrence records. As a result AECOM believes that all species were considered in our analysis for which there is a documented basis for doing so.

In my professional judgment a literature review of wildlife species that may potentially be present does not provide a sufficient environmental assessment of site characteristics. Importantly, not all relevant sources were included in the literature review and numerous bird species that have been documented to be present in nearby comparable habitat were not included in the report.

C. Terrestrial and aquatic plant life: When the Site is viewed in the context of the overall ecological system, including climate and surrounding geology, NWNA's conclusions, regarding "no detrimental impact" to wetland communities, are not supported.NWNA project calculations of the percent drawdown is predicated on current aquifer recharge and spring flow characteristics – current climate trends, as documented by the Intergovernmental Panel on Climate Change (IPCC) (Ray et al, 2008), clearly show a decline in runoff with correspondingly reduced stream flows and aquifer recharge. Thus the percentage of drawdown from pumping will likely increase in a warming climate scenario, and thereby increases the potential for aquifer dewatering and related impacts to wetland habitat.

This comment suggests that approval of proposed projects evaluated under the 1041 regulations is based on potential impacts under future (i.e., predicted or modeled) conditions rather than current or historical hydrogeological conditions. Furthermore, the reference cited (Ray et al., 2008) is primarily concerned with forecasted hydrogeological conditions within the Colorado River Basin rather than the Arkansas River Basin. The referenced study also states that the prediction of future climatological conditions is uncertain and in some cases poorly constrained. Specifically, "in all parts of Colorado, no consistent long-term trends in annual precipitation have been detected. Variability is high, which makes detection of trends difficult. Climate model projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050" (Ray et al., 2008, p. 1). With respect to future changes in stream flow that have been predicted, Ray and others state that "The range of individual model projections within a single study can include both increasing and decreasing runoff due to the range of climate model output used to drive the hydrology models. Ongoing studies are

attempting to resolve methodological differences in order to reduce the range of uncertainty in runoff projections" (p. 2). Given the current state of knowledge, it seems tenuous and illogical to base project approvals on climatological conditions that are predicted (with considereble uncertainty) to occur many years in the future. Finally, as a safeguard, NWNA is proposing a long-term wetlands monitoring program to identify any significant adverse impacts to wetlands flora and fauna that are potentially related to groundwater withdrawals from the Ruby Mountain and Bighorn sites.

Climate is a major driver in aquatic ecosystems. As previously stated, because climate, precipitation and streamflows are linked, consideration of Colorado's changing climate is essential to any decisions regarding allocation of water resources

Although climate change impacts are difficult to assess some trends and associated impacts are clear. Those trends in the Arkansas River Basin, as elucidated by the Colorado Climate Report, 2008, include increasing temperatures that even with no change in precipitation will lead to a decline in runoff for most of Colorado's river basins by the mid 21st Century.

Although the study from Ray et al., 2008 has a focus on the Colorado River Basin the study also supplies and analyzes data for the upper Arkansas River Basin; here 30 year trends from 1977 to 2006 show a 1.55°F temperature increase.

Given the current state of knowledge regarding the impact of climate change on water resources in the West I strongly recommend erring on the side of caution by conserving the water resources that are predicted to be impacted by our changing climate. The Colorado Climate Report (wwa.colorado.edu/CO_Climate_Report/index.html) is clear when it states that "In Colorado temperatures have increased by approximately 2°F between 1977 and 2006. Increasing temperatures are affecting the state's water resources" and that "**Changes in the quantity and quality of water may occur due to warming even in the absence of precipitation changes**"

An evaluation of the project as it relates to the uncertainties and various predictions on future climate is not a specific requirement of the Chaffee County 1041 application process. Ongoing monitoring, evaluation, and management of the resources and the communities upon which they depend however will be a part of NWNA's stewardship. Projections for the Arkansas River are for a 5 to 10% reduction in runoff (average from 2041 to 2060) compared to the 1900 to 1970 baseline. Available historic data for the Arkansas River near Nathrop has an average daily flow of approximately 700 cfs (1965 – 2007). The projected change indicates that flows may fall to 665 to 630 cfs. In comparison the proposed withdrawal (200 acre-ft/year) is less than 0.3 cfs.

Although consideration of climate change is not a specific 1041 requirement it remains an important consideration for water managers. For instance, changes in long-term precipitation and soil moisture can affect groundwater recharge rates; coupled with demand issues, this may mean greater pressures on groundwater resources (wwa.colorado.edu/CO_Climate_Report/index.html).

II. Specific Comments

A. Floodplains, wetlands and riparian areas.

Numerous small wetlands emerge on the alluvial outwash terrace at the interface between the Mosquito Range (Arkansas Hills) and the Arkansas River. These wetlands are uniquely located and are a stark contrast between xeric upland and surrounding valley floor habitat. As such they are an important component of the natural history of Chaffee County and provide potentially critical habitat for a diversity of native wildlife.

1. As reported in the NWNA project proposal, the amount of available water in the aquifer at the site is approximately 12,488 acre-feet. The proposed withdrawal would be approximately equivalent to 1.6% of the available amount of water and would be equal to 1.4% to 2.1% of the average annual recharge to the aquifer (Appendix I, Groundwater Investigation, Section 2 and

Executive Summary).
a. The cumulative amount withdrawn from the aquifer is a critical factor in determining impacts on native ecosystems. Within the 890-acre site area, NWNA has identified 7 wells and 30 users that may be withdrawing from the site aquifer (Appendix I, Groundwater Executive Summary, Section 9). Although the proposed amount to be withdrawn by NWNA may not by itself negatively impact the aquifer, the cumulative withdrawal may exceed the sustainability of the aquifer thereby impacting wetland ecosystems that the aquifer supports.

The number of wells cited above is not consistent with the number of wells discussed in the 1041 permit application. Appendix I, Groundwater Executive Summary, Section 9 of the NWNA application states 10 domestic wells are listed in the CDSS database within the 890-acre Site Area. There are 30 wells listed in the CDSS database that are located within the approximately 3,122 acre-aquifer located on the eastern side of the Arkansas River in the Study Area. The amount of water consumed by the other users in the aquifer is extremely small relative to the estimated recharge to the aquifer, thus their influence on the sustainability of the aquifer is considered inconsequential. There are a total of 30 wells that were identified within the Study Area that are believed to be installed in the overburden aquifer. Twenty-two (22) of these wells are identified as domestic wells. Assuming these domestic wells are all in use, the number of people per well is 2.26 (based on 2000 US Census Bureau average population per household in Chaffee County, Colorado), and each person uses 60 gallons of water per day (Wastewater Engineering, Metcalf & Eddy, 1991), 3.34 acre-feet of water would be withdrawn from these wells annually. The majority of water withdrawn for domestic use is returned to groundwater via on-site subsurface disposal systems, so the impact to the aquifer relative to consumptive use is irrelevant. Typically a consumptive use of 10% is assumed for domestic users with on-site wastewater systems in water augmentation plans (Watts, 1985). Given this percentage of consumption, assuming 90% of withdrawn water is returned to the aquifer; only 0.334 acre-feet would be lost annually from these domestic users. The six (6) commercial well permits designate their use for domestic and irrigation purposes. Four of the six commercial well permits have annual withdrawal limits that total 4.4529 acre-feet. One commercial well that supplies a rafting business has a maximum permitted yield of 20 gpm and has listed drinking, sanitation, and irrigation as its uses. Its annual withdrawal is likely substantially less than maximum well yield given the uses listed. No permit information was available for one commercial well. All of these commercial users discharge waste water through subsurface disposal systems, so consumptive losses are considered irrelevant with respect to the estimated recharge to the aquifer. One of the two wells listed for livestock use is a bedrock well, the other can be assumed to withdraw water from the same aquifer from which the proposed NWNA borehole will withdraw. Information regarding the type and number of livestock and water consumption rates are not available, so estimates of withdrawals for this user cannot be made; however, consumptive losses are likely considerable less than groundwater withdrawal rates.

The number of wells considered in the review was the number of wells that occur within the 890-acre site area.
From the NWNA Groundwater Executive Summary, Section 9, *"Within the 890-acre Site Area there are ten wells identified for domestic use according to the CDSS database (Table 2 and Figure 5). Two of these wells are located on the western side of the Arkansas River and at least one is a bedrock well, thus they are hydraulically isolated from the aquifer pertaining to this proposed withdrawal."*

I strongly believe that the cumulative and future impact of numerous withdrawals is an important consideration in maintaining long-term ecosystem sustainability.

b. Additionally, agricultural and domestic withdrawals are mostly return flows to the stream and do not ultimately deficit the system whereas none of the NWNA project

withdrawal is returned and contributes to a water deficit.
The majority of the agricultural and domestic withdrawals are returned to the aquifer and stream, and thus do not result in a substantial consumptive loss from the aquifer. The proposed NWNA withdrawal will be a consumptive loss from the aquifer, but the volume withdrawn annually is estimated to represent 2.1% or less of the recharge to the aquifer. A water deficit is not anticipated given the hydrogeological characteristics of the aquifer and the magnitude of recharge to the aquifer. A wetland groundwater and surface water monitoring program will enable the identification of tendencies toward deficit conditions and allow for proactive mitigation measures to be taken if needed.

2. ***NWNA indicates that withdrawals would not exceed 10% of average total spring/seep flow (Final Application text Page 5) and that the total water to be extracted annually would be approximately 200 acre-feet (= 124 gpm). A key consideration is whether or not the NWNA withdrawal would be adjusted to actual flow rates or if the proposed withdrawals would be keyed to a long-term average flow rate.***
a. In a drought situation, spring/seep flows could be much less than average and the NWNA drawdown of 124 gpm could then actually be much greater than 10%.
The period of direct record on spring discharge at the Ruby Mountain and Bighorn Springs sites does not cover the range of flows through history or into the future. There may be years during which the requested allocation of 200 acre-ft/year (an average of 124 gpm) exceeds 10% of the average spring discharge. Based upon observations collected to date, however, the requested allocation is anticipated to represent less than 10% of the typical annual average. Furthermore, a ratio of 10% or less is not a design requirement.

b. Seasonal variation in spring/seep flows is dramatic (Final Application, Figure 1) and year-to-year variation can also be highly variable (Groundwater Executive Summary, section 5), so that again, a drawdown of 124 gpm could effectively be much greater than 10%.
Again, 10% is not a design metric, it is an estimate based upon available information. NWNA will respond to droughts through monitoring and using information from the monitoring network to drive management practices.

c. ***NWNA states that seasonal withdrawal amounts may vary upon demand with higher demand occurring in summer months compared to winter months when demand is lower (Appendix H, Surface water investigation, section 1); and that although the total average yearly withdrawal will not exceed 124 gpm during peak demand, withdrawal could increase to 170 gpm during "demand" season.***
Pumping tests demonstrated that a withdrawal of 170 gpm from the Ruby Mountain site during the May low-flow season is currently sustainable (Phase 1, Hydrogeological report, p. 4-10) and that a portion of the withdrawal is to come from the Bighorn site (Appendix H, Surface Water Investigation, section 1). However, increased demandbased withdrawals would occur at a time of the year when flows are actually near a seasonal low or are recovering (Final Application, figure 1). So that withdrawal percent could actually increase substantially during "demand" season if NWNA projected spring/seep flows are less than average.
As discussed in the application package, AECOM indicated that the sustainable rate of pumping during the seasonal low-flow period of 2008 was between 157 and 169.5 gpm, two of the steps during our Spring 2008 pumping test.
The summer demand period would occur during the peak flow period of the Arkansas River (May through August). The flow pattern for the springs is much different – beginning to rise from springtime lows in June, and peaking in the fall.
In my opinion test pumping data indicates that there is the potential for substantial dewatering of the aquifer with a commensurate reduction in spring/seep flows in an extended drought and/or reduced recharge scenario. Hydrogeological data indicate that at just slightly higher pumping rates the aquifer (upper portion of the screened interval)

could potentially become dewatered under a 180-day no-recharge scenario (Phase I, Hydrogeological report, p. 4-10). In such a dewatering scenario impacts to wetland vegetation and habitat would likely be negative and significant.

If the water levels in a pumping source go below the screen, the potential damage is to the pumping source, not the aquifer. When AECOM projected water levels in RMBH-2 out 180-days under a no-recharge scenario, the sustainable rate of pumping from that source under the seasonal low-flow period was estimated to be between our two highest rates of the test (157 gpm to 169.5 gpm). Water levels in a pumping well are a reflection of well performance and aquifer characteristics. To evaluate the response of the aquifer to pumping, one needs to look at water levels in monitoring wells. During the Spring 2008 test, water levels in the Ruby Mountain test borehole (RMBH-2) fell by only 7.91 feet while pumping at up to 169.5 gpm. Water levels in two nearby monitoring wells (90 to 190 feet away from the borehole) fell by less than 0.5 feet. No response was observed in any of the other monitoring wells (1,300 or more feet away). During the January 2008 test, water levels in the Bighorn test borehole (BHBH-2) fell by 3.81 feet while pumping at 70 gpm., while water levels in a monitoring well (90 feet away) fell by only 0.61 feet. No response was observed in any of the other monitoring wells (1,300 or more feet away). Water levels recover relatively rapidly following the cessation of pumping, particularly in RMBH-2 where 94% of the drawdown recovered within 15 minutes. This information clearly shows that the aquifer would not be significantly stressed or dewatered by the proposed project.

Water levels in production boreholes are not allowed to be drawn down below the top of the screen due to the potential for disturbing the gravel pack and native porosity around the screen. This disturbance would negatively impact the performance of the borehole, so it is standard practice in the water supply business to put measures in place to prevent water levels from falling to such a level. Thus, even if the dewatering of the upper portion of the screen could be related to impacts to wetlands and associated habitat, source management would prevent that occurrence from happening.

*d. **As identified by NWNA, a high degree of fluctuation in seasonal flow rates characterizes spring/seep flow (Final application, Page 6, Figure 1) which, in my opinion, indicates that the alluvium at the spring sites is thinner and that spring/seep flows are closely tied to recharge at the surface. Indeed, in the area where the springs are located, the NWNA groundwater report (section 2) describes a narrowing of the Site due to an outcrop of rhyolite and a thinning of the aquifer due to the Site being underlain by rhyolite. The hydrogeologic report identifies recharge as primarily by infiltration of stream flows from side creeks and by direct precipitation (Phase I, Hydrogeologic report p 1-1,1-2).***

In the Ruby Mountain area, the total thickness of the aquifer (Pinedale outwash) is on the order of 60 feet thick, although this thickness is variable throughout the valley. In places where it is known to be somewhat thicker, water-level fluctuations have actually been observed to be much higher. The aquifer is not thin, and seasonal fluctuations in flow are not related to that thickness. Rather, those fluctuations result from seasonal variations in recharge and how that recharge propagates throughout the aquifer. Water-quality data collected from the site over the last 18 months have clearly demonstrated both a very high quality of water and very stable physical properties. Geochemical evidence demonstrates that the water emanating at the project springs is primarily tied to recharge from the Mosquito Range. Some of that comes from the discharge of side creeks, such as Arnold Gulch and Trout Creek. The feature draining Arnold Gulch, which includes numerous mapped springs within its bedrock uplands, generally soaks into the ground before reaching accessible portions of the valley floor. Geochemical evidence demonstrates that a large portion of the flow in Trout Creek (which sinks into the Pinedale outwash approximately 2 miles to the North) results from the discharge of ground water to the stream (baseflow). All along the Pinedale outwash and bedrock interface, recharge is likely to be entering the valley through a network of bedrock fractures.

Irrigation applications on the northern portions of the aquifer result in a mounding of ground water; however, that water is of a very different character than the water discharging at the project springs and boreholes. Similarly precipitation events play a role, especially due to the very high infiltration capacity of the overlying soils. The infiltration of surface-water into a ground-water system can cause a host of waterquality issues. During the 18 months of observation, no water-quality signal has been observed that could be related to "recharge at the surface" despite the fact that looking for such a signal was one of the primary goals of the ongoing monitoring program.

As you approach the river to the west, the aquifer becomes thinner due to the incision of the channel within the alluvial deposits. As you go south towards the Bighorn Springs and Ruby Mountain sites, the aquifer also becomes narrower as it begins to pinch out between the bedrock of the Mosquito Range to the East, and Dorothy's Butte to theWest. The high concentration of ground-water discharge at the project sites results from the geologic constraints on the aquifer and a generally southward groundwater flowpath.

Characteristics of the aquifer create a situation in which the aquifer is especially sensitive and responds rapidly to changes in streamflow and precipitation. Streamflows are also highly variable due to geologic characteristics. The surrounding bedrock uplands have less storage capacity, which confers less system resiliency and results in more fluctuation in the overall hydrologic system; flashy upland stream flows quickly run off and are not stored in surrounding soils where they would otherwise supply a more steady discharge to maintain more consistent stream flows.

Soils in the bedrock upgradient of the aquifer are very limited and do not provide any significant buffering between individual recharge events (precipitation) and contact with the bedrock itself. However the bedrock has a well developed fracture network. Some of those fractures result from the manner in which the unit was emplaced (igneous intrusion and volcanic extrusion with the attendant formation of cooling joints), and some are the result of more recent and extensive faulting. Those fractures interconnect and feed each other, resulting in relatively permeable bedrock. The evidence for that is clear in maps of the area, which show numerous springs originating from bedrock within the Arnold Gulch and Trout Creek watersheds. Many of those springs are located at local topographic lows along mapped fault traces. Ground water moving through this fracture network towards the valley encounters the highly permeable materials of the Pinedale outwash. At the surface, two of the four mapped soils overlying those coarse deposits are described as being somewhat excessively drained, capable of taking 2.0 to more than 20 inches per hour. A third soil, which represents alluvial deposits along the flanks of the Mosquito Range, is described as excessively drained. The fourth soil type is described as well drained (0.6 to 6 inches per hour), and generally occupies those portions of the valley that are subject to irrigation. In short, hydrogeologic conditions upgradient of the project springs and boreholes provide highly buffered conditions, as evidenced by water-quality, water-level, and spring-discharge data that have been collected over the last 18 months. None of the data collected near the sites indicate that the aquifer is sensitive to or responds rapidly to "changes in streamflow and precipitation". Rapid changes to recharge events result in clear signals that would show up in the data record as short-term spikes in discharge and water levels, or rapid changes in water-quality parameters. All changes observed to date show only gradual responses to seasonal patterns of recharge, not rapid responses to individual storm events.

Due to these watershed characteristics, drawdowns during even short-term drought situations, in my opinion, may put the aquifer and springs/seeps at significant risk.

The hatchery has been in operation for more than 40 years, with the sole source of water being discharge from the springs. In addition, a local resident has reportedly observed these springs for over 70 years. The flow of those springs has been described by these long-term residents and observers as constantly flowing with some minor seasonal variations. There was a period when the spring discharge reportedly

dropped significantly during the filling of the Trout Creek reservoir (January through May, 2001), however the conditions described in that report do not sound significantly different than conditions observed more recently. Some of the springs have a seasonal discharge pattern, drying up during portions of the year. At both sites, other springs discharge on a continual basis. The timing of the filling of the dam coincides with the period in which spring discharge begins to decline towards a natural seasonal low. In addition, the conditions during 2001 were likely exacerbated by the multi-year drought of the period and decreased irrigation practices by the junior upgradient irrigators.

The dam may have had an impact throughout the aquifer, essentially shutting down the recharge to the uppermost portions of the aquifer from one of its largest and most consistent contributors, the Trout Creek watershed. No quantitative information on water levels in the aquifer or spring discharge rates at the sites exists to analyze or accurately evaluate what may have occurred during the period in question. In contrast to some of the relatively dramatic changes that reportedly occurred during the filling of the dam, water levels in the surrounding aquifer have shown a relatively minor and highly localized response to the pumping of the test boreholes

Additionally, the adjacent Mosquito range and the upper Arkansas valley, of which the Ruby Mountain and Big Horn springs sites are part, is naturally arid due to a rainshadow effect. Wetland and riparian habitats in this arid ecosystem are unique and especially valuable to wildlife. Due to geologic and climatic characteristics these springs, seeps and riparian areas are also especially sensitive and less resilient to hydrologic alteration. Low-flow/dry season conditions are an especially critical time of year to the survivability of natural communities and wetland ecosystems. Drawdowns that exacerbate already low-flow environmental conditions may stress the community and its inhabitants beyond the capacity for recovery and survivability.

The saturated aquifer thickness at the Big Horn and Ruby Mountain spring sites has been documented as at least 16 and 33 feet, respectively. Spring/seep flows are closely tied to recharge. Recharge to the aquifer causes the elevation of the groundwater to rise at varying degrees across the Study Area depending upon the mechanism of recharge. Overall the groundwater elevation ranges from higher levels in the north to lower levels in the south near the spring sites. This difference drives the flow of groundwater toward the south and southwest. The fact that the aquifer is thinner in the southern portion of the aquifer does not make this area any more sensitive to recharge than the other areas of the aquifer.

Water levels at the spring sites do not vary rapidly with precipitation events. Seasonal variations in the aquifer water levels occur primarily due to the differences in recharge from the Mosquito Range and through irrigation activities in upper portions of the aquifer. The large size of the aquifer buffers the rate at which changes in water levels occur due to its inherent storage capacity. The current monitoring data illustrate the annual water-level variations that have occurred. The aquifer water levels and spring flows will be monitored and the data used to manage the withdrawals appropriately. Wetland conditions will also be monitored to ensure any potential impacts from the withdrawals are addressed.

Please see our responses to Comments A.1-3. Water table levels and water quality are being monitored and will continue to be monitored using small diameter monitoring wells located between the spring sites and Johnson Village. Long-term monitoring of water table levels, water quality, wetland species composition, hydrology, and areal extent of wetlands will be completed to assess potential impacts related to groundwater withdrawal at the Bighorn Spring and Ruby Spring sites.

3. Global Climate Change

NWNA indicates that aquifer recharge comes from three primary sources, direct precipitation, infiltration from drainage runoff (especially Trout Creek and Arnold Gulch) and infiltration from irrigation return flows (Appendix I, Groundwater Executive Summary, Section 3). NWNA project data indicate that spring/seep discharge quantity

is heavily dependent on sustained recharge to the aquifer: they calculate that their withdrawal of 200 acre-feet/year would be equal to 1.4% -2.1% of estimated annual recharge in a normal year and as much as 5.5% in a drought year assuming precipitation and irrigation are similar to the past 10 years (Appendix I, Groundwater Executive Summary, section 3 and 11). Data from the IPCC (Ray et al, 2008) clearly show that our Colorado climate will not be the same as it has been in the past ten years. Climate trends in the upper Arkansas River valley show a clear and dramatic temperature increase. Climate trends are toward warmer winters and springs with snowmelt occurring 5 to 14 days earlier in the West, including the Arkansas River basin (USGS, 2008).

First of all, climate models predict that future climate will change relative to long-term averages. It needs to be noted that the last ten years have included some of the driest and warmest on record, and as such those data represent a conservative basis for evaluating the project in terms of a drier and warmer climate.
Not all of the climate models agree on several important variables, most importantly whether or not the mean annual rate of precipitation will increase or decrease (Ray et al, 2008). Furthermore, reductions in snowpack seen elsewhere in the western United States have not been realized in Colorado due to the elevations at which it forms throughout the state (Ray et al, 2008). The snowpack is critical to streamflow patterns in the west. Due largely to the protection of that feature, streamflows in the Arkansas River are predicted to decrease by a relatively moderate 5 to 10% by 2050 (relative to the 1900 to 1970 baseline).
The Arkansas River near Nathrop discharges at an average annual rate of approximately 700 cfs. NWNA's requested withdrawal (200 acre-ft/year, or 0.28 cfs) represents only 0.039% of that average. The average flow rate may decrease to approximately 630 to 665 cfs by 2050 (5 to 10%), which would increase the relative proportion of the withdrawal to only 0.042 to 0.044%. In addition, augmentation water will be provided to offset those withdrawals, and NWNA will be required to respond as appropriate to any water calls made by the holders of senior rights within the Arkansas River basin.
An evaluation of the project as it relates to the uncertainties and various predictions on future climate is not a requirement of the Chaffee County 1041 application process. Ongoing monitoring, evaluation, and management of the resources and the communities upon which they depend however will be a part of NWNA's stewardship. They, like all water users, may experience some changes in the availability of water, and, most likely a change in the timing of the peak streamflow/recharge season

Climate is a major driver of aquatic ecosystems. In my professional judgment any consideration of alteration to aquatic systems in the arid West requires a serious consideration of climate change and the impacts that are clearly predicted to occur with regard to water resources.

Because climate, precipitation and streamflows are linked, consideration of Colorado's changing climate is essential to any decisions regarding allocation of water resources. In the upper Arkansas River basin since 1945 there been a clear, statistically significant trend toward earlier streamflow, which is attributed to winter and spring warming (USGS, 2008). The report from the USGS (2008) also states that if trends continue many mountain landscapes will endure increasingly severe summer-drought conditions.

The powerpoint presentation referred to here does include some predictions for the much larger and more climatologically diverse upper Colorado River (at Lee's Ferry, Arizona), however the models generally agree (Ray et al, 2008) that the Upper Colorado will be subject to significantly more change than the Arkansas River. The slide that indicates increasing concern meeting the requirements of the Colorado Compact (the closest reference to "severe summer-drought conditions") presents some simulated distributions of annual flow, which the presenter (Patrick Edelmann, Chief of the Southeast Colorado Office in Pueblo) noted as "Preliminary results, do not cite".

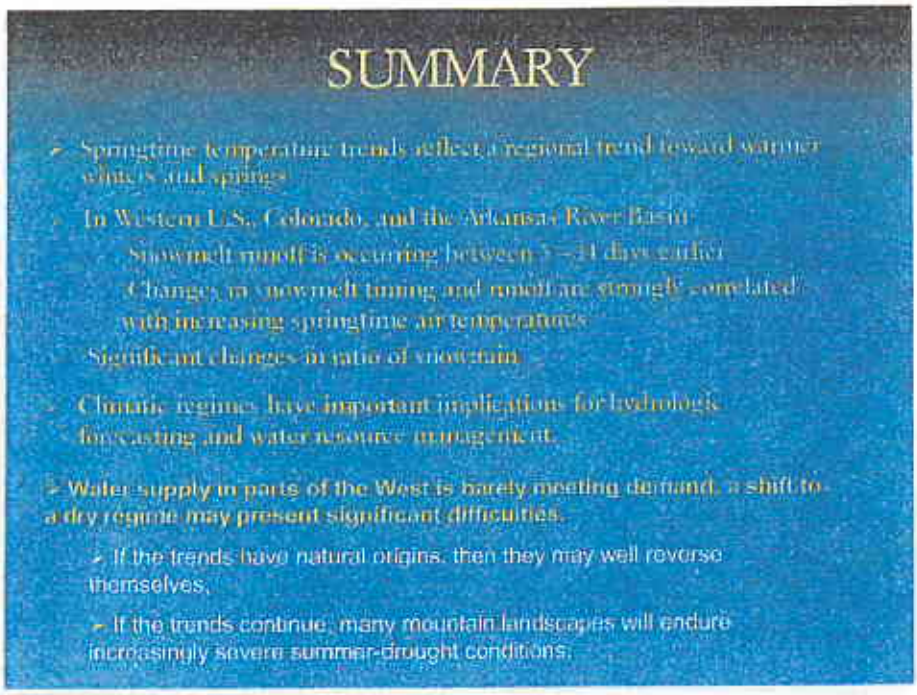
The presentation does highlight a critical issue within the Arkansas River, the operation of the numerous tunnels upgradient of Buena Vista that transfer water out of the basin. The volume of those diversions changed dramatically around 1970, rising from 47,740 acre-feet to 125,649 acre-feet. The operation of those diversions and upgradient reservoirs complicate the task of analyzing changes in streamflow in the Arkansas River relative to climate change (USGS, 2008).

In fact, the power point that was referenced (Ray et al, 2008) is the summation of a larger report which targets several watersheds in Colorado and includes the upper Arkansas valley (page 12 and 17). The full text of the report is available online at http://cwcb.state.co.us/.
The Colorado report acknowledges that there has been relatively little work done on the Arkansas, Rio Grande and Platte river basins but goes on to synthesize results of data from these areas and provides major findings which include:

- **Climate in Colorado is highly variable compared to other states**
- **The mountains and elevation make Colorado's climate unique compared with other Western states**
- Temperatures have been increasing in Colorado and will continue to rise
- **Uncertainty in precipitation projections**
- Even in the absence of precipitation changes, temperature increases alone combined with related changes in evaporation and soil moisture lead to a decline in runoff for most of Colorado's
- river basins by the mid-21st century in all recent hydrologic projections

- **A synthesis of findings in this report suggests a reduction in total water availability by the mid-21st century**

Only one slide in the USGS presentation (slide number 22), a slide regarding stream flows in the upper Colorado, was noted as "Preliminary results do not cite". Slides both before and after did not have this notation. Summary conclusions from the USGS (2008) are:



Climate change predictions for Colorado from the IPCC (Ray et al, 2008) indicate that

precipitation patterns and corresponding infiltration, recharge and discharge patterns and seasonal stream flow rate patterns will also change. Their primary conclusions based on IPCC data are:
1) Temperatures are increasing and will continue to increase;
2) there is uncertainty with regard to precipitation projections;
3) Even with no change in precipitation, temperature increases alone will lead to a decline in runoff for most of Colorado's river basins by the mid 21st century; 4) Synthesis of findings suggests a reduction in total water availability by the mid 21st century; and that 5) a warming climate increases the risk to Colorado's water supply even if precipitation remains at historical levels. Climate models project Colorado will warm by 2.5°F by 2025, relative to the 1950–99 baseline, and 4°F by 2050. The projections show summers warming more (+5°F) than winters (+3°F) and suggest that typical summer temperatures in 2050 will be as warm as or warmer then the hottest 10% of summers that occurred between 1950 and 1999; from 1957 to 2006 the average year-round temperatures in the upper Arkansas River basin have increased by 2o F (Rey et al, 2008).

4. Spring/aquifer connection. NWNA hydrogeologic research documents a direct physical connection between the springs that supply water to the wetlands and the underlying aquifer (Phase I, Hydrogeologic report, p. 4-4, 5-2, and 6-3); both the Ruby Mountain and Bighorn Springs showed a clear response to pumping. Their observations suggested to them that the host aquifer for Ruby Mountain and Bighorn Springs is the alluvial-outwash aquifer (Phase I, Hydrogeologic report, p. 5-2).
a. NWNA research documents that the aquifer, from which these springs emanate, is primarily recharged by infiltration of stream flow from side creeks as they spill onto the valley floor and that these streams are sourced from bedrock uplands and mountains (Phase I, Hydrogeologic report, pp. 1-1, 1-2, and 2-2). Additionally, their report indicates that direct precipitation, including snowmelt, as well as irrigation return flows are also important sources of aquifer recharge (Phase I, Hydrogeologic Report, p. 5-2). Climate trends will alter stream flows and aquifer recharge rendering predictions about pumping sustainability unsupported and inconclusive.
Several hydraulic tests have been conducted on the test boreholes under a variety of hydrogeologic conditions. All of those tests have demonstrated the combined ability to provide water in excess of the requested allocation. How the climate may change and how those changes may impact aquifer recharge, ground-water levels and springdischarge rates are unknown. Evaluating the project in terms of such unknowns is not within the scope of the Chaffee County 1041 Permit Application.

b. Shallow alluvial aquifers, such as this one, transmit a reduction in groundwater levels quickly with a result that can include cessation of spring flows: when Trout Creek was dammed recharge to the aquifer was diminished and spring discharge on the Hagen property on the valley floor was significantly reduced or in some locations ceased (Phase 1 Hydrogeologic report, p. 2-3). As indicated by the NWNA report, this condition was likely exacerbated by the existing drought.
The watershed that supplies the streams and aquifer is relatively small and in the Site area the aquifer is relatively shallow (Appendix I, Groundwater Executive Summary, section 2). Additionally, the watershed's geologic characteristics result in rapid runoff and reduced storage in surface soils. In my assessment these factors indicate that the stream and associated wetland and riparian systems are less resilient to environmental changes and less able to moderate perturbations. Geologic characteristic of the watershed result in stream flows that are highly responsive to precipitation events – with little storage capacity to absorb flows and discharge energy that would otherwise moderate flow fluctuations.

Viewed as a system the Site is highly sensitive to changes in the flow regime. Even small drawdowns could dewater the aquifer in times of extended drought.

Most of these comments under 4.b have been addressed in responses elsewhere. The comments and concerns regarding the sensitivity of this aquifer and its potential to respond rapidly to minor variations in recharge directly contradict the monitoring data that have been collected over the last 18 months. Water levels, water quality, and spring discharge rates do show some gradual seasonal trends, but those do not reflect a sensitive aquifer, or an aquifer that responds rapidly to short-term changes in hydrogeological conditions.
If the climate trends toward warmer winters and springs, declining stream flows, and more extreme periods and higher frequencies of drought, as referenced in the reviewer's comments, there may be periods of time when the amount of water that can be extracted from the aquifer without negative impacts on the associated ecosystems will diminish. The future hydrologic conditions of the project site area, aquifer area, contributing watershed area, and the Arkansas River basin are not known so assessing potential impacts from withdrawals under such unknown conditions is not possible. In order for the project to be viable, the proposed withdrawals must be sustainable. To that end, a monitoring program will be put in place to ensure the withdrawals are managed responsibly with respect to background variations in the aquifer.

B. Terrestrial and Aquatic Animals and Habitat
Wetland habitats are necessary for the survival of a disproportionately high percentage of wildlife species in the Rocky Mountain West. Although only 3 % of Colorado's landscape are wetland habitats approximately 40% of plant species, 75% of the birds and 80% of mammals live in or migrate through these areas (Huggins, 2004). NWNA's proposal has not taken into consideration the several documented species of special concern that occur in adjacent and comparable upland and wetland habitats. Although no federally listed species have been observed, with the exception of the Gunnison's prairie dog (Cynomys gunnisoni) which is being considered for listing, numerous 'ranked' species have been recently observed in nearby areas with similar habitat and resources. Species 'ranking' indicates that populations are at risk, primarily because of habitat loss or alteration, rarity or degree of imperilment. Thus their occurrence indicates the presence of habitat that is essential to survivability. This remaining habitat is especially valuable and essential to the long-term survivability of those ranked species.

Upland habitat. Active Gunnison prairie dog (GUPD) colonies are documented by the Colorado Division of Wildlife (CDOW) in Chaffee County near Nathrop on both sides of the Arkansas River and directly adjacent to the proposed NWNA pipeline route (Figures 1 and 2) (CDOW 2009). As corroborated by the NWNA report (Terrestrial and aquatic species and habitat appendix, p.3), two active GUPD colonies are present immediately adjacent to the proposed pipeline route. The colonies are located in upland habitat east of the Bighorn Springs wetland site. (Figure 1).
In central Colorado, GUPDs inhabit mountain parks at sites ranging in elevation from 5,997 – 11,998 feet (CDOW 2008). In these high elevation sites GUPDs occupy grasslands and mesic shrublands on open, flat to gently rolling terrain with deep, well-drained soils for burrow development (Fitzgrald et al. 1994, CDOW, 2009)). GUPD diet consists mostly of grasses but forage requirements vary with the season and they switch among plant species as they become available during the growing season; sagebrush is browsed during early spring, forbs in the summer as they become available and finally grasses, sedges and rushes are consumed as they ripen in the late summer (Fitzgerald et al. 1994 and Seglund et al. 2005). GUPDs play an essential role in maintaining ecosystem integrity. Prairie dog burrowing activity creates an oasis of species diversity that has resulted in their being considered keystone species. Burrowing activity creates an ecosystem that favors plant diversity and promotes the growth of perennial grasses and forbs favored by livestock and native ungulates; their burrows are refugia for numerous small mammals, burrowing owls and reptiles and amphibians; they are an important prey for predators such as eagles and hawks; and their burrowing activity enriches primary productivity, soil structure and soil chemistry (Miller et al. 1996, CDOW 2009). Vegetation, soil and topographic characteristics on upland portions of the NWNA property provide the habitat conditions necessary for GUPDs. Upland vegetation, as described in the NWNA vegetation report (Appendix M, pg. 2 and 5) consists of grassland and shrubland/forestland types;

grasslands primarily consist of herbaceous species such as blue grama (Bouteloua gracilis) and wheatgrass (Agropyron spp.) and several woody and cacti species including rabbitbrush (Chrysothamnus nauseosus) and prickly pear (Opuntia polyacantha). GUPD colonies throughout the Basin are fragmented (CDOW 2009, USFWS, 2009). Fragmentation and isolation puts prairie dogs at higher risk of extinction and disrupts the function of the entire system putting both the prairie dog and associated species at risk (Miller et al 1996, CDOW 2009, USFWS 2009). Possible direct adverse impacts to prairie dogs associated with pipeline development include 1) clearing and crushing of vegetation; 2) reduction in available habitat; 3) fragmentation of available habitat; 4) prairie dog displacement and mortality; 5) increased soil compaction; and 6) increased exposure to shooting-induced mortality. Gunnison's prairie dog is being considered for Federal listing and Prairie dog burrowing activity provides essential habitat for numerous wildlife species including the burrowing owl (Athene cunicularia), which is listed by the CDOW as a State threatened species. Although burrowing owls have not been observed in Chaffee county, suitable habitat is present near the Site at the GUPD colonies and they have been recently observed in Gunnison County in comparable habitat and at comparable elevation (Jason Beeson, 2009). Although the NWNA assessment suggests that the probability of the occurrence of burrowing owls is low (Terrestrial and aquatic species and habitat report, p. 5), their recent sighting in Gunnison County in combination with the presence of active prairie dog colonies suggests that burrowing owls may indeed be present in Chaffee County at GUPD colonies. Any activity that impacts prairie dogs, upon which owls are totally dependent for burrows, also has a negative impact on burrowing owls PIF, 2009). If Chaffee County approves this project I would recommend that the County consider requiring prairie dog conservation measures such as those identified by the BLM in their Vernal Draft Management Plan available at http://www.blm.gov/ut/st/en/fo/vernal/planning/rmp/draft_rmp_eis/draft_rmp_eis.html. Additional management recommendations follow in III. B.

The Gunnison's prairie dog and burrowing owl were considered in the analysis. The document explains that currently no Gunnison's prairie dog colonies occur within the Project site but that several colonies exist immediately adjacent to the pipeline route. However, the majority of the pipeline route parallels a county road and railroad Right-of-Way (ROW) and does not cross any prairie dog colonies; therefore impacts to the Gunnison's prairie dog would be minimal. The document also explains that there is a small potential for burrowing owls to occur near or within the Project site. However, looking through scientific literature and other sources (e.g., Colorado Breeding Bird Atlas), there are no records of burrowing owls in Chaffee county; therefore this species has a low probability of occurring near or within the Project site. Due to Gunnison's prairie dogs not occurring at the Project site, the recommended conservation measures are not needed. Their applicability to the pipeline route is minimal due to the pipeline route not crossing Gunnison's prairie dog colonies.

Recreational shooting is a major cause of prairie dog and burrowing owl mortality. Increased access and visitation to the site resulting from development will increase the potential for shooting mortality. Prairie dog colony viability is dependent on the ability of the colony to migrate across the landscape. Development that inhibits colony migration or fragments the landscape also reduces the long-term survivability of colonies. NWNA project upland habitat provides appropriate prairie dog habitat but the proposed development may contribute to habitat fragmentation.

With regard to burrowing owl occurrence; wherever appropriate habitat occurs there is the potential for the species to occur. This GUPD colony provides appropriate habitat for burrowing owls. Importantly, burrowing owls have been recently documented in Gunnison County at a similar elevation and in comparable habitat.

Wetland and adjacent upland habitat. Numerous bird species have been observed in the area in close proximity to the Site that were not included in the bird list submitted by NWNA (Terrestrial and Aquatic species and habitat, Table 1). Although none of these observed birds are currently federally listed (peregrine falcon was removed from the federal register but is now a State listed

species of special concern) many are tracked as species of special concern and some of these have been documented as breeding. Tracked birds recently observed near the NWNA Site include; peregrine falcon observed near Nathrop and possibly nesting; loggerhead shrike (Partners in Flight ranking) and juniper titmouse (USFS ranking) observed on the West side of the Arkansas River near the confluence with Dry Creek; Brewer's sparrow(Audubon, PIF and USFS ranking) possibly nesting and northern pygmy owl (CNHP watchlist) both observed on the western side of the base of Ruby Mountain, Virginia's warbler (Audubon ranking) confirmed nesting and pygmy nuthatch (USFS ranking) both observed near Nathrop, and cordilleran flycatcher (PIF ranking) in riparian habitat on the Arkansas near Buena Vista. Species accounts are from Colorado Natural Heritage Program, Rocky Mountain Bird Observatory and Colorado Breeding Bird Atlas 2008 and 2009 data records. Numerous other non-tracked bird species have also been observed in nearby, comparable habitat. Although these species are not tracked they are, nonetheless, an important part of the natural history of Chaffee County and many of these species are indicators of habitat condition. In my experience the following bird species are typical in the surrounding landscape and are important indicator species. A casual count of (non-tracked) bird species observed in 2008 included; near Ruby Mountain at the Arkansas River gray flycatcher, green-tailed towhee, black-throated gray warbler, cedar waxwing, Townsend's solitaire, bush tit and western wood-peewee; at Dry Creek and the Arkansas River western tanager and fox sparrow; further upstream near Buena Vista in riparian habitat on the Arkansas River Wilson's warbler and blue-gray gnatcatcher; and upstream of Buena vista in riparian habitat near the confluence of 4-mile Creek and the Arkansas black-headed grosbeak, gray catbird, spotted towhee, and song sparrow. Bird species can also be especially good indicators of wetland function. The quality and function of riparian habitat is in large part determined by vegetation characteristics. Breeding birds select nesting habitat based on a suite of environmental variables including the quality, quantity and structure of vegetation. Bird surveys conducted by NWNA were inadequate to provide either a basic census of the breeding bird community or to give any indication of habitat function. Historical accounts of bird species near Salida include Colorado rare species such as Golden-crowned night heron and Willow flycatcher (Warren, 1910) and numerous other ranked species that were then common including loggerhead shrike and MacGillivray's warbler. Habitat loss is the major cause for the decline of species. Wherever a sufficient amount of suitable habitat exists there is the potential for the occurrence of these species.

The CNHP did not provide a tracked bird species list during the initial data request on 1/25/2008. However, we realize that tracked and non-tracked bird species may be found within appropriate habitats at the Project site during the appropriate time of year. The 1041 permit application does not specifically focus on individual tracked or non-tracked species but rather focuses on wildlife communities and niches (e.g., raptors, migratory birds). The exception would be unless the bird species is federally listed, state listed, or a state species of concern. A site visit was conducted in late-April/early-May 2008 and an inventory of wildlife observed, including migratory birds, was initiated. The list of birds observed at the site during this 3 day period was meant to serve as baseline information for the analysis.

Chaffee County 1041 regulations require the project to "Describe and indicate on a map terrestrial and aquatic animals including the status and relative importance of game and non-game wildlife, livestock and other animals; a description of streamflows and lake levels needed to protect the aquatic environment; description of threatened or endangered animal species and their habitat. (Chaffee County 1041 submittal requirements 3-302 (e) (i)).

Documentation of terrestrial and aquatic animals as provided in the submission by NWNA was largely dependent on literature reviews. As stated by the AECOM wildlife biologist during our meeting on February 27th, 2009, "our goal was NOT to do a wildlife census" and "no surveys of any wildlife" were conducted. In my professional judgment a literature review is inadequate to accurately characterize the community of wildlife at a given site and is insufficient to provide baseline data for a monitoring plan.

With specific regard to bird species: In my professional judgment a breeding bird assessment includes both a bird census and thorough and current literature review, including all relevant sources, of bird species and communities in a given area. Numerous sources, including but not limited to CNHP, are available to provide information on the current status of bird species and communities. Most importantly, a baseline survey of breeding birds should be conducted several times during the breeding season (May through June). Different species breed and display at different times during the breeding season so that a single survey can only rarely identify all species present.

C. Terrestrial and Aquatic Plant Life.
Wetland habitat and vegetation wholly depends on a sufficient and reliable water source. As identified in the NWNA proposal a clear and direct connection exists between the aquifer and both the Ruby Mountain and Bighorn springs/seeps and supports Site wetlands. Hydrology is probably the single most important determinant of the establishment and maintenance of wetlands and even small changes in hydrology can result in significant biotic changes (Mitsch and Gosselink, 2000). Drawdowns as proposed by the NWNA project will reduce flows and may alter wetland hydroperiod. Climate change induced reductions in runoff, streamflow and aquifer recharge may then actually increase the percent of withdrawal. Maintenance of wetland function and structure are dependent on hydrologic conditions, which affects species composition and richness, primary productivity, organic accumulation and nutrient cycling in wetlands (Mitsch and Gosselink, 2000). The water source that sustains both palustrine and riparian wetlands at the Site are the springs and the underlying aquifer.

1. Palustrine wetlands. Generally speaking palustrine wetlands are non-tidal wetlands that are supported by shallow groundwater discharge; all of the wetlands in the project area are in this category. Riparian wetlands are those palustrine wetlands adjacent to a flowing body of water that are, at least periodically, influenced by flooding; riparian wetlands in this project are riverine wetlands in terms of their water source but are also very likely supported by ground water discharge and so dependent on both river flooding and shallow groundwater discharge. NWNA describes two "low-quality" palustrine wetlands at the Ruby Mountain Site, and at the Bighorn site one high-quality wetland, 12 moderate-quality and three low-quality wetlands: They go on to say that heavy grazing has modified and is responsible for reducing wetland quality (Appendix M, Wetland/riparian areas, p. 3) and provide a list of wetland communities and dominant plant species in table 1 (Appendix M, Final wetlands table). The wetland report also states that from information provided by several agencies, populations of Federally listed species or their habitat are not known to occur in the study area (Appendix M, Final wetlands, p. 6).

a. In my opinion wetland "quality" is best assessed by first identifying a natural wetland that is functioning at potential and that is located in a similar environmental setting that can be used as a baseline criterion. This wetland can then be used as a yardstick with which to compare other wetlands. Quality is then based on whether or not the wetland is functioning at potential.
For the 1041 permit application, wetland delineations and quality assessments were conducted based on the USACE's 1987 Wetland Delineation Manual and subsequent guidance. As part of this assessment, wetland quality is one of the indicators measured. This is a subjective indicator, and is based on the expertise and experience of the wetland delineator in the field. It is assessed using species composition, vegetative cover, soils, hydrologic indicators, and human disturbances such as grazing.
As noted throughout this document, wetlands have many functions such as sediment retention, flood control, wildlife habitat, etc. Not all functions will be performed by one wetland, nor will the functions it performs be consistent over time due to both natural and anthropogenic factors. Determining the exact functions of the wetlands in the project area is beyond the scope of this application and the subsequent monitoring program.
A key aspect of the wetland delineation that was completed at the sites was to determine

the areal extent of the wetlands and the quality of these wetlands. The Wetland Monitoring Program that will be developed in cooperation with Colorado Division of Wildlife (CDOW) and implemented by NWNA will monitor the areal extent of these wetlands, wetland quality, and other attributes associated with these wetlands, including hydric soil indicators and hydrology, to determine if the wetlands are affected by groundwater withdrawals.

Chaffee County 1041 regulations require a project to " Map and/or describe all floodplains, wetlands, and riparian areas to be affected by the proposed project, **including a description of the types of wetlands, species composition, and biomass** and a delineation of the 100-year flood event (Chaffee county 1041 submission requirements 3-302 (d) (i)).

Wetland vegetation species composition was not sufficiently described. Wetland delineation and vegetation assessments, although conducted to USACE standards, were not conducted with sufficient detail to adequately provide baseline information for wetland assessment, or to develop an adequate monitoring plan, or to identify sensitive species. The majority of wetland vegetation was not identified to the species level, without species level identification, changes in the plant community that may occur as a result of hydrologic alteration cannot be detected. While some plant species are tolerant of environmental degradation others are intolerant. Understanding the composition of a plant community is an essential aspect of vegetation assessment. Importantly, because wetland vegetation was identified only to the genus level, any sensitive or threatened plant species that may have been present could not be identified.

Regarding wetland functions: One function of wetlands is to provide wildlife habitat. Reciprocally, vegetation and wildlife species are good indicators of properly functioning wetlands. In other words, if a natural community of wildlife is present in a given wetland then the wetland is likely functioning at potential. Thus, a thorough and accurate list of wetland vegetation and animal species is an important part of wetland assessment and monitoring protocols.

b. My personal bias is that there are no low-quality wetlands, rather wetlands that are functioning at potential or those that are not. Frequently functioning below potential is a result of unsustainable management practices. Wetland function can often be restored with the cessation of unsustainable management practices if there is a sufficient and reliable water source with a natural hydroperiod.

Wetland quality will be assessed using USACE wetland regulations and guidance as part of the Wetland Monitoring Program.

The purpose of the USACE wetland delineation procedure is to enable people who are not botanists to delineate a wetland for jurisdictional purposes and legal protection. The purpose is NOT to establish a baseline for future monitoring. As such, because USACE guidelines do not require species level vegetation identification they are inadequate to develop a baseline for future monitoring.

c. In my estimation documentation given in the NWNA report does not provide sufficiently detailed information over an adequate period of time to make a determination as to whether or not the Site wetlands are functioning at potential, particularly at the Bighorn Springs area; however, the Ruby site has been severely altered by human development which has clearly diminished wetland function and potential. Wetland hydroperiod is a key determinant of wetland function while vegetation and wildlife community composition and structure are key indicators of function. Baseline data regarding these characteristics is essential to making a determination regarding wetland function. Neither has been sufficiently assessed to enable a determination regarding sustainability of the proposed drawdown.
Please see our response to C.1.a

d. Vegetation surveys were conducted throughout Chaffee County in 2008 by the CNHP. Although the NWNA project site was not included in the CNHP survey, other nearby, comparable habitats were surveyed. Although no federally listed species or communities were observed by CNHP, tracked plant communities were documented. These communities were often structurally complex with a species-rich plant community that supported a rich and abundant bird community. Additionally the Colorado natural Areas Program has documented the occurrence of a tracked plant species in nearby upland habitat comparable to upland habitat at the Site.
AECOM does not anticipate impacts to upland habitat and associated plant species as a result of the proposed project.

From page 1 of the NWNA Terrestrial and Aquatic Species and Habitat appendix describes impacts to upland habitat; "Wildlife habitats potentially affected by the proposed Project include grassland, shrubland/forestland, wetland and riparian habitats"; and from page 6 "Impacts to wildlife from project-related surface disturbance would include the temporary (short term) reduction of habitat and largely be the result of pipeline construction; and from page 2 of appendix M " A short-term loss of up to19.5 acres of upland vegetation associated with the water pipeline and production boreholes in the Bighorn Springs and Ruby Mountain Springs areas would occur as a result of project construction."

2. Impacts to Palustrine Wetlands. Source water for palustrine wetland habitat is identified primarily as subsurface and ephemeral flows (Appendix M, Executive summary, p. 4), which the hydrogeological and groundwater reports tie to the underlying aquifer. At the Bighorn site potential impacts to wetlands from pumping are identified as a decrease in size or loss of three "low-quality" wetlands within close proximity of the well (#s 3,4 and 5), and also that the margins of one moderate quality (#6) and one high-quality wetland (#2) may be affected by drawdown (Appendix M, Executive summary pp. 3,4,5). Additionally, the report states that "these wetlands may decrease in size or transition into upland vegetation …if a substantial amount of subsurface water flow is affected by drawdown" (Appendix M, p. 4). NWNA is proposing a monitoring plan to assess the potential impacts of pumping at the Bighorn site, although they also state that the majority of wetland #2 is not likely to be affected by withdrawals (Appendix M, Executive summary, p. 4)
a. NWNA reports have indicated that maximum withdrawals would be a relatively small percentage of total available spring/seep flows and that NWNA maximum withdrawals would occur during summer months. Summer is a season of the year when water is critical to vegetation maintenance and growth and to the wildlife that depends on wetland resources for breeding, foraging and cover. Summer is also the season of the year that is likely to be most effected by climate change with warming- induced reduction in aquifer recharge and spring/seep flows reduced.

Please see our responses to Comment A.1-3 on hydrology and climate change.

b. NWNA's conclusion that the majority of wetland # 2 is "not likely to be affected by withdrawals" may not be valid. When viewed in the context of the entire system, drawdown impacts to the wetland may be greater than suggested. The underlying aquifer is relatively shallow in this location and water storage is thus reduced. Also, due to surrounding geology in combination with the local climatic rain-shadow conditions aquifer recharge is highly variable and tenuous. Consequently the system has reduced reserves and is less resilient and thus more susceptible to degradation by even small flow alteration. Even short-lived alterations in stream flows that recharge the aquifer have been shown to produce dramatic changes in spring/seep flows as evidenced by the temporary cessation of spring/seep flows corresponding to the damming of Trout Creek and filling of the reservoir. Longer term drawdowns may have an even greater impact and ultimately alter wetland vegetation and function.
See our responses to comments A.1-3 and 2d

Additionally, given the documented trend toward climate warming in the Arkansas River valley and throughout the West with corresponding changes in aquifer recharge and spring/seep flows, actual withdrawal percentage may be much greater than anticipated.

See our response to comment A 3

c. Proposed withdrawals will also affect the wetland natural hydroperiod which can affect wetland stability. Wetland hydroperiod is the wetlands' signature – the seasonal pattern of the water level of a wetland and is an integration of the inflows and outflows of water, surrounding topography and soil and groundwater condition. (Mitsch and Gosselink, 2000).

See our response to comment 2d

d. The report states that wetlands 3, 4, and 5 may be affected by drawdown and then states that they are "low quality" and have been heavily grazed (appendix M). Even "low quality" wetlands can recover and sustain biota but for correctable habitat conditions. In the case of the "low-quality" wetlands sustainable grazing practices in combination with sufficient and reliable water sources with a natural hydroperiod would likely restore these sites to a more functional condition.

Wetland delineations and quality assessments were conducted to provide baseline data for determining current wetland conditions. This information will be used to monitor the potential effects of groundwater withdrawals on wetlands in the project area. Restoration of the Ruby Mountain Springs Site to a more natural condition is described in the 1041 Application. The restoration project will include the removal of all structures and infrastructure associated with the existing residences and fish hatchery, and the restoration of the site to a more natural state. Restoration work will be permitted through the U.S. Army Corps of Engineers (ACOE), and in consultation with the Colorado Division of Wildlife (CDOW), Trout Unlimited (TU), Colorado Mountain College (CMC), perhaps the Arkansas Headwaters Recreation Area (AHRA), and other local specialists. Grazing on the Bighorn Springs Site properly has occurred historically. At the suggestion of CDOW, NWNA anticipates managing the site holistically for continued cattle grazing and habitat protection.

Again, Chaffee County's 1041 regulations require a description of the types of wetlands, species composition, and biomass. However, the USACE methods used to characterize the wetlands do not include species level identification of wetland vegetation nor do they adequately characterize wetlands for the purpose of establishing baseline conditions for future monitoring. Wetlands 3,4,and 5, like the majority of wetlands at the site, are slope wetlands and are dependent on groundwater discharge. Flow alteration may alter plant species composition.

e. From the NWNA wetland report the areal extent of proposed monitoring is not clear. Will monitoring be conducted on only wetland 2 or will monitoring include all wetlands in the Site area? Vegetation composition and structure is a key determinant of habitat quality. Will monitoring include a thorough vegetation assessment beginning with baseline conditions?

Detailed information regarding monitoring activities will be provided in the Wetland Monitoring Plan currently being developed with CDOW.

f. In my view, monitoring should be an integral aspect of the project. Monitoring should use a landscape focus and begin with establishing wetland potential by first identifying reference wetlands in similar environments that are functioning at potential and then using these as a yardstick by which to compare other wetlands. The reference wetland can also used to set goals for mitigation. Specifically a monitoring plan should be structured for adaptive management and include:
1) Identification of reference wetlands

2) Determination of the normal hydroperiod in the reference and site wetlands.
3) Establishment of vegetation monitoring plots to quantitatively measure in detail vegetation cover, structure and species composition.
4) Establishment and conduction of breeding bird censuses during appropriate times of the year using point-count surveys and nest searches.
5) Ongoing collection and synthesis of data to determine and mitigate any impacts to the wetland system.

A Wetland Monitoring Program will be developed in accordance with CDOW and implemented by NWNA as part of this project. Monitoring will focus on the wetlands in the project area and the potential effects of groundwater withdrawals associated with the project. Baseline conditions of the wetlands in the project area have been documented and will be used to monitor the areal extent of the wetlands, possible changes in wetland species composition and abundance, and the hydrology of the area. Water table levels and water quality are being monitored and will continue to be monitored using small diameter monitoring wells located between the spring sites and Johnson Village. Long-term monitoring of water table levels, water quality, wetland species composition, hydrology, and areal extent will be used to determine if groundwater withdrawals will affect these wetlands.

Again, baseline habitat conditions, especially with regard to vegetation and wildlife have not been adequately established.

3. Impacts to riparian wetlands. Riparian wetlands have been identified along the Arkansas River, Bighorn channel, Arnold Gulch, and the Hatchery ditch. The wetland report (Appendix M, p. 5) suggests that riparian areas in the Bighorn Springs and Arnold Gulch area would not be affected by drawdown since willows have deep roots and subsurface and surface flows would not be substantially affected by drawdown; and that riparian vegetation along the Arkansas would not be affected by drawdown since associated vegetation is supported by water from the river. NWNA reports also indicate that drawdowns would reduce flows in the Bighorn springs channel by 8% to16% and would reduce the wetted width of the channel by 6% to 10% (Surface water executive summary p. 10).
Riparian vegetation relies on flowing water for moisture and nutrients and also to remove metabolic waste. Reducing flows in the spring channels and the amount of the channel that is filled with water would diminish both out-of-bank flows and associated functions and may well impact wetland vegetation and habitat. With regard to riparian vegetation along the Arkansas River: the groundwater report (p.7) suggests that a considerable amount of groundwater likely discharges directly into the Arkansas where the aquifer is incised by the river. In my opinion, riparian vegetation along this stretch of river, similar to other reaches in the area, may be dependent on both water from the river (during high flow season) and shallow groundwater discharge (during low flow season) for sufficient year-round moisture. Reduction in either may negatively impact riparian vegetation.
NWNA agrees that substantial reductions in either Arkansas River flows or shallow groundwater discharge to the river may impact riparian vegetation. However, the analysis presented in the 1041 application shows that the proposed project will not have a measureable impact on Arkansas River flows or on shallow groundwater near the river.
The flow characteristics through the Bighorn Springs channel, the Arnold Gulch channel, and the Ruby Mountain channel are all highly buffered systems, not prone to flooding or significant stormflow inputs. As such, "out-of-bank flows" are extremely rare events and do not play a large role. Such large and rare events would not be impacted by the relatively minor withdrawals proposed by the NWNA. The channels and associated riparian wetlands are accustomed to seasonal fluctuations. Arnold Gulch is a classic example of that, with flow naturally ceasing over much of its length under moderate-to-low flow conditions. In the Bighorn Springs and Ruby Mountain channels, the withdrawal is anticipated to cause a 6 to 10% reduction in the wetted channel length at thecurrent flow measurement locations. Those locations represent a point of restriction within the channels. Within the more natural portions of the channels, the reduction would generally be much smaller.

A site visit in February of 2009 confirmed my assessment that spring discharge at the banks of the Arkansas where the river has incised into the alluvium is the primary source of water for riverine riparian vegetation along this river reach. Consequently, drawdowns that affect the amount of discharge along the banks may also impact riverine riparian vegetation.

The proposed Wetland Monitoring Program will be designed to observe changes in wetlands and associated habitat. With the majority of withdrawals planned for the Ruby Mountain site, where wetlands and habitat are significantly altered by the associated hatchery, impacts would be minimal. Habitat at Ruby Mountain is likely to actually improve over the existing condition due to the planned restoration of the facility. Withdrawals from the Ruby Mountain borehole primarily impact the springs feeding the Ruby Mountain channel, and represent a small overall proportion of that flow. A portion of the withdrawal may impact ground water seeping out of the aquifer elsewhere along the banks of the Arkansas River, however that small volume would be spread out over a large area and would not have a significant or measureable impact.

4. Floodplain vegetation and impacts to terrestrial and aquatic plant life. According to the NWNA wetland report (Appendix M, p. 6) populations of federally listed species or the potential habitat are not known to occur in the study area. However, surveys by CNHP and Colorado Natural Areas Program have identified tracked plant communities in nearby comparable upland and wetland habitat. (Brian Kurzel, 2009).

III. Management Recommendations

A. Wetland management recommendations

1. Reduce and manage grazing pressure; depending on vegetation assessment some limited grazing may be desirable for maintenance of certain plant communities.

NWNA will manage the site holistically for both grazing and habitat protection.

2. Determine natural hydroperiod and baseline conditions: Monitor water level in reference and Site wetlands throughout the year.

Water levels will be monitored using the existing network of small diameter monitoring wells and wetland piezometers to be installed as contemplated in the Wetlands Monitoring Program.

Details of a wetlands monitoring program has not been provided.

3. Maintain sufficient groundwater flow to wetlands.

Groundwater flow to and areal extent of those wetlands will be monitored to assess potential effects to wetlands from groundwater withdrawal.

Effective monitoring requires that baseline habitat conditions be established prior to flow alteration. Although a monitoring plan is mentioned for the Big Horn Springs site a monitoring plan is not mentioned for the Ruby Springs site.

4. Eradicate/manage noxious weeds and non-native plant species.

Noxious weeds will be managed as directed by federal, state and local regulations.

5. Revegetate with native plant species using the reference wetlands as models of natural species diversity.

Restoration work on the Ruby Springs site will be permitted through the U.S. Army Corps of Engineers (ACOE), and with consultation from Colorado Division of Wildlife (CDOW), Trout Unlimited (TU), the Colorado Mountain College (CMC), potentially the Arkansas Headwaters Recreation Area (AHRA), and other local specialists.

6. Locate any recreational trails away from and out of wetland and riparian zones; establish and harden specific fishing ingress/egress trails; install educational signage.

Recreation and educational access and opportunities are being explored with CDOW and AHRA. Comments will be considered in the public planning and permitting process.