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May 16, 2017 Project No. 2035-099

Secretary of the Commission
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: Denver Water's response to comments received on the Final FERC License Amendment Application for the Gross Reservoir Hydroelectric Project, FERC Project No. 2035.

Dear Secretary of the Commission:

On February 1, 2017, the Commission issued the Notice of Application Accepted for Filing, Ready for Environmental Analysis, Soliciting Comments, Motion to Intervene, Protest, Recommendations, Terms and Conditions, and Fishway Prescriptions for the Gross Reservoir Hydroelectric Project, FERC Project No. 2035. This public notice initiated a 60-day comment period on Denver Water's Final FERC License Amendment Application ("Application"), which ended on April 3, 2017. Denver Water's reply to comments are due 105 days from the issuance date of the notice by the Commission (comment reply deadline May 18, 2017).

Boulder County and the United States Forest Service each entered a Motion to Intervene. Denver Water does not oppose either party being given intervener status. In fact, Denver Water is filing a letter with Boulder County to request that they engage in settlement discussions utilizing FERC's Dispute Resolution Service.

During the comment period, FERC received numerous letters in support of Denver Water's Application. The FERC also received letters containing comments on the Application from individuals, The Environmental Group, and Boulder County. Denver Water has reviewed and provided responses to comments received during the 60-day comment period on the Final FERC License Amendment Application. Denver Water's responses to comments are provided as an enclosure to this letter.

If you have any questions, please feel free to contact me at (303) 628-6318 or via email at brian.gogas@denverwater.org.

Sincerely,

Brian Gogas
Environmental Scientist

Enclosures: Response to Comments

Attachment 1 – Gross Dam Noise Impact Report (May 2017)
Attachment 2 – Gross Dam Reservoir Expansion Traffic Control Plan (December 2015)
Attachment 3 – Boulder County Commissioners Letter (May 8, 2017)
Attachment 4 – Final Memo – Evaluation of the Final Quarry Location Report (May 2017)

Denver Water Responses to Comments Received on the
Final FERC License Amendment Application – Comment Period

RESPONSE TO NEPA AND CWA COMMENTS:
Numerous comments provided to the FERC during the comment period for Denver Water's Final License Amendment Application ("Application") are the same or similar to comments submitted to the U.S. Army Corps of Engineers ("Corps") and pertain to the adequacy of the Environmental Impact Statement ("EIS") and the Corps' Clean Water Act ("CWA") regulations. Many of these comments were also submitted to Denver Water and the Federal Energy Regulatory Commission ("FERC") during the consultation process for Denver Water's Application. These EIS and CWA related comments have previously been addressed in Denver Water's Summary of Consultation and by the Corps throughout the EIS process. The Corps was the lead agency developing the EIS, with FERC, the Environmental Protection Agency, Colorado Department of Natural Resources and the Colorado Department of Public Health and Environment participating as Cooperating Agencies. Grand County was granted Consulting Agency status relative to effects on county resources. Thus, the environmental analysis required by FERC in Exhibit E of Denver Water's Application was developed using the EIS, in which FERC was a Cooperating Agency.

Denver Water categorizes these EIS and CWA comments with its response as follows:

<u>Purpose and Need</u>: The purpose and need for the Moffat Collection System Project ("Moffat Project") was evaluated and verified by the Corps. Denver Water believes it was appropriate in the EIS to integrate the underlying needs into one defined purpose and need statement since Denver Water's needs are not independent, but are interconnected parts of the water supply issues it faces. Specifically, the proposed additional supply and reservoir shortage address a projected shortfall in supply and an imbalance in Denver Water's water collection system that results in system-wide vulnerability issues and limited operational flexibility to respond to system outages, all of which can seriously jeopardize Denver Water's ability to meet its present-day needs. Denver Water's assessment of its need was evaluated by the Corps, and the Corps extensively evaluated the original and new demand data. The basic assumptions underlying the Moffat Project have not changed. Additionally, customer demand is not the only justification for additional supply.

In additional to a CWA §404 permit for the dredge and fill activity associated with the Moffat Project, Denver Water is required to seek approval from FERC in order to construct and operate aspects of the Moffat Project that are within FERC's jurisdiction (the "Proposed Project") and amend its existing license (Gross Reservoir Hydroelectric Power Project License, Project No. 2035).

<u>Alternatives</u>: The EIS studied a reasonable range of alternatives sufficient to demonstrate reasoned decision making. The alternatives encompass a variety of potential water supplies, storage sites and infrastructure components. Six alternatives were evaluated in the EIS. Each EIS alternative that would involve an expansion of Gross Reservoir would require approval from the FERC to amend the license.

Additionally, the hydropower project alternatives to the Proposed Project are included in Section 2.0 of the Application. Section 2.0 of Exhibit E describes the Proposed Project, which includes the construction and operation of facilities appurtenant to the hydroelectric project, including installation of a PRV and includes recreation facilities required in the existing FERC license. Section 2.0 also describes the FERC's No Action alternative – FERC's denial of the proposed amendment to the hydroelectric project (i.e. maintain the existing license).

<u>Analysis of Impacts</u>: The EIS analyzed six alternatives, included new information on (updates to) current conditions, including the magnitude and effect of existing withdrawals on the West Slope, and an improved analysis of hydrologic alterations and potential for threshold changes to flows and aquatic life. Agencies are not

required to consider speculative impacts or actions. Moreover, agencies are entitled to rely on their own experts where commenters disagree with the methodology or conclusions about a particular impact. The Corps considered the same or similar comments to these comments raised during the review of Denver Water's Application, and Denver Water believes the methods used by the Corps and the analysis in the EIS are adequate and extensive. The number of resource areas evaluated in the EIS is consistent with other EIS documents published by the Corps, as is the size and volume of the EIS; and the extent and scope of the EIS is consistent with NEPA requirements. The EIS considered all foreseeable direct and indirect impacts and cumulative impacts. With regard to numerous comments about construction impacts, the EIS in fact analyzes the short-term and temporary impacts (e.g. noise, vibration, dust, socioeconomic impacts, etc.) for all construction activities associated with the construction of the Moffat Project, including hauling material, tree removal, and quarry operations; it addresses the long-term effects of the Moffat Project, including the hydrologic effects associated with the additional diversions for water supply; and it discloses the effects on all resources that might be affected by both short-term and long-term impacts associated with the construction and operation of the Moffat Project.

Mitigation: The EIS includes a discussion of possible mitigation measures to avoid adverse environmental impacts. Appendix M of the EIS contains a substantial and robust discussion of a wide range of mitigation measures for nearly every aspect of the Moffat Project and satisfies NEPA requirements to evaluate and publicly disclose the proposed mitigation measures. Since publication of the Final EIS, Denver Water has also prepared the mitigation proposed in Exhibit E of its Application to offset impacts of the Proposed Project. Denver Water has also worked with the Corps to develop its CWA §404 Compensatory Mitigation Plan, as well as other mitigation it will propose to the Corps to address other impacts identified in the EIS. Through the numerous permit conditions, agreements, and license conditions, Denver Water believes it has presented an extensive mitigation and enhancement proposal that results in a net environmental benefit with the Moffat Project.

Supplemental EIS: Throughout the NEPA process, the Corps provided numerous opportunities for public review and comment on the Draft and Final EIS. The consultation process for Denver Water's Application similarly included numerous opportunities for public review and comment. It is Denver Water's understanding that the Corps continues to evaluate comments and any new information since the release of the Final EIS prior to issuing its Record of Decision and §404 permit for the Moffat Project, even though an agency need not supplement an EIS every time new information comes to light after the EIS is finalized. Comments during the NEPA process and Denver Water's consultation process indicate that new information, such as climate change studies and Denver Water's customer demands require new analysis. However, the EIS adequately analyzed these issues, and both Denver Water and the Corps have taken these comments into consideration. Denver Water's response to these issues are found in the Summary of Consultation within the Application and below.

Kaplan, Kirsch & Rockwell Comment Letter (on behalf of Miramonte):
Internal Denver Water Comment Tracking Number: MIR-01
Comment and Letter Reference: Page 1, Paragraph 1, Item 1

"1. A land trade between both parties for approximately 15 acres to replace that which is to be condemned."

Response:
Miramonte was provided notice that Denver Water must acquire real property interest in lands owned by Miramonte that are within the proposed FERC boundary. While Denver Water has the right to condemn real property interests, Miramonte and Denver Water are meeting frequently to develop a Memorandum of Agreement (MOA) and are also exploring alternatives to condemnation, such as exchanging real property interests. Denver Water anticipates a determination on how it will acquire the real property interests within the next six months. As soon as there is resolution on this issue, but no later than one year before construction of the Proposed Project, Denver Water will inform FERC how it plans to acquire the real property interest to these lands.

Internal Denver Water Comment Tracking Number: MIR-02
Comment and Letter Reference: Page 1, Paragraph 1, Item 2

"*2. Replace the lower road which provides critical access for our client (Miramonte). The road is within the FERC permit boundary and needs to be moved."*

Response:
Denver Water and Miramonte have an existing agreement whereby Miramonte residents are allowed access to the Miramonte property via an access road on Denver Water's property. Denver Water and Miramonte are in the process of developing a MOA which, among other items, will include a new access road. Denver Water will submit a copy of the final MOA to FERC.

Internal Denver Water Comment Tracking Number: MIR-03
Comment and Letter Reference: Page 1, Paragraph 1, Item 3

"3. Replace and add fencing to protect our client's (Miramonte) property from the influx of new visitors who will be closer to the property."

Response:
In the MOA that is currently being developed between Miramonte and Denver Water, Denver Water is offering to provide a fence, or signs where the terrain is not conducive to fencing, to prevent trespass onto Miramonte's property. Denver Water will submit a copy of the final MOA to FERC to demonstrate resolution of the issues raised by Miramonte.

Internal Denver Water Comment Tracking Number: MIR-04
Comment and Letter Reference: Page 1, Paragraph 1, Item 4

"4. Fire mitigation efforts."

Response:
In the MOA that is currently being developed between Miramonte and Denver Water, Denver Water is offering to pay for the development of a wildfire mitigation plan specific to Miramonte's property to aid with their fire prevention.

Internal Denver Water Comment Tracking Number: MIR-05
Comment and Letter Reference: Page 1, Paragraph 2, Sentence 1

"Concerned about the new plans to build a quarry to supply material to the project and its current location. The new proposed site is adjacent to the homeowners' property line. Its proximity to eight residences and the animal barn will undoubtedly have a significant negative impact on our client's quality of life and their right to enjoy their property. Drilling, blasting and trucking of material for up to 16 hours a day with its dust and noise will be extremely disruptive. We request that you consider relocating the quarry closer to the dam site and away from our client."

Response:
Based on comments from Miramonte, Boulder County and others, Denver Water commissioned a noise study in February 2017, (Attachment 1 – *Gross Dam Noise Impact Report – May 2017)* to better understand what the anticipated noise levels will be to neighbors from the proposed quarry operations at Osprey Point and the dam construction activities. Like the previous noise studies conducted by Denver Water to better understand the noise levels associated with blasting and trucks hauling material, this study similarly verified the conclusions of the EIS and establish that noise levels at the EIS quarry and at the Osprey Point quarry will be below local noise ordinances. Nonetheless, Denver Water recognizes that any increase in noise levels above ambient will be a different environment than normal in this mountain community. Denver Water intends on using these noise studies as a tool to work with the local community, including Miramonte, to develop measures that aim to monitor, minimize, and mitigate noise disturbance during construction, to the extent reasonable and possible. For example, Denver Water is considering the use of project noise goals and potential forms of restitution when construction activities exceed those goals at determined monitoring locations.

Denver Water is in a position which requires a thoughtful balancing of all impacts to the site and our neighbors. While locating the quarry at Osprey Point may have greater temporary noise impacts to certain neighboring landowners, it may have less impact on others. Locating the quarry at the Osprey Point Quarry site not only removes the quarry from public National Forest System lands, it also provides the temporary aesthetic benefit of shielding the view of the quarry from residences and a permanent aesthetic benefit of locating all or nearly all of the quarry below the normal high water surface.

Internal Denver Water Comment Tracking Number: MIR-06
Comment and Letter Reference: Page 1, Paragraph 2, Sentence 6

"We assume, because the location of the on-site quarry was not considered in the Environmental Impact Statement, that a new or Supplemental Environmental Impact Statement will be required."

Response:
In its Application, Exhibit E, Attachment E-4 (Final Quarry Location Report Moffat Collection System Project – September 2016) Denver Water compared the impacts of the EIS quarry to the proposed Osprey Point location. The Corps' consultant reviewed and verified the conclusions in Denver Water's Quarry Location Report. Please see Attachment 2 – "Evaluation of the *Final Quarry Location Report: Impact Minimization and Avoidance Measures, Moffat Collection System Project*, prepared by Denver Water," In this memorandum, the Corps' consultant determined, "the Osprey Point Quarry site would result in no impacts, have similar impacts as the FEIS Quarry site, or reduced impacts from the FEIS Quarry site due to a reduction in land disturbance and off-site haul trips."

Internal Denver Water Comment Tracking Number: MIR-07
Comment and Letter Reference: Page 1, Paragraph 3

"If FERC and Denver Water determine not to move the quarry location, the homeowners' property will be severely negatively affected by the quarry operations. The negative effects include impacts from noise, blasting, vibrations, dust, light pollution, and the truck traffic for many years. The homeowners require that Denver Water engage in the best available mitigation practices to minimize the disturbances of the property during the duration of the construction and operation phases of this project."

Response:

Denver Water is committed to minimize construction related impacts to our neighbors. As mentioned above, Denver Water will use the 2017 Noise Study to communicate the anticipated noise levels, which are below local ordinances, with the local community. Denver Water also proposed in Section 5.1 of Exhibit E of the Application to develop a Quarry Operations Plan. Similarly, Denver Water proposed to include the local community, which includes Miramonte, in the development of its proposed Traffic Management Plan and Tree Removal and Disposal Plan (see Denver Water's proposed mitigation in Exhibit E, Section 5.1). Input and ideas from the local community is essential to determine practicable methods (such as determining preferred times of machinery operations and truck deliveries) to minimize the disturbances caused by the day-to-day construction activities.

In addition, Denver Water commits to incorporate high safety standards and best management practices into the design of the construction activities.

Internal Denver Water Comment Tracking Number: MIR-08
Comment and Letter Reference: Page 2, Last Sentence

"The homeowners also require compensation for damage to their property including loss of use and reduction in value."

Response:

As described in the EIS and in Section 3.3.19.1 (Socioeconomics) of Exhibit E of the Application, it is not anticipated that there will be any diminishment in property values or loss of use resulting from construction or operation of the Proposed Project. Please refer to Denver Water's Summary of Consultation response to this comment found in paragraph B(3)(i) on page 22 of the Summary of Consultation.

Form Comment Letters (includes letters following commenters: Beverly Kurtz, Kathleen Doyle, and Yvonne Short):

Internal Denver Water Comment Tracking Number: FORM-01 through FORM-09

Comments:

> ***"The purpose and need for the Moffatt Project based on projections of water supply and demand cannot be validated. The demand model used is faulty"***
>
> ***"Per DWs own 2015 Comprehensive Annual Financial Report, treated water consumption is decreasing as population is increasing"***
>
> ***"All calculations of demand are based on unrestricted use of water during a drought which is not realistic"***
>
> ***"The entire supply system is immense, has built in flexibility, and is reliable as has been demonstrated during drought of 2002-2004"***
>
> ***"Reservoir capacity does not tell the entire story. The critical pinch point is the capacity of the Moffat Treatment Plant. Additional storage in Gross Reservoir does not change that capacity"***
>
> ***"Criteria used by the Army Corps of Engineers to identify acceptable alternatives for study was too narrow(selection must deliver water to the Moffat Collection System) and hence the Least Environmentally Damaging Practicable Alternative was not appropriately evaluated."***
>
> ***"Consequences of not increasing supply to the Moffatt Treatment Plant are speculative. No quantitative analyses are provided."***
>
> ***"Problem to be solved is not lack of stored water - it is a lack of a conveyance system. The solution to getting water north is not by compensating with a bigger reservoir, but by building conveyance systems"***
>
> ***"Alternatives were eliminated based on faulty cost estimates and biased the analysis in favor of the selected preferred alternative."***
>
> Response:
>
> Please refer to Denver Water's response to NEPA and CWA related comments above.

Internal Denver Water Comment Tracking Number: FORM-10 and FORM-11

Comments:

> ***"The EIS estimates a total cost of $139.9 million while the FERC application estimates $364.1 million. The higher figure can be corroborated so the alternatives were evaluated based on faulty data."***
>
> ***"Recent upgrades to Moffat plant enable it to handle agricultural/reusable water. All cost estimates that included the costs to build an advanced water treatment plant are now inaccurate as upgrades are no longer needed."***

Response:
The estimated costs presented in the EIS for the five action alternatives were originally developed by MWH Global and Boyle Engineering Corporation to evaluate the relative cost between action alternatives. The cost estimates were developed over several years and were based on varying timelines and dollar years. In 2008, Harvey Economics (the Corps' third party contractor) adjusted the action alternative cost estimates to normalize all the costs to year 2006 dollars. Table 2-22 of the final EIS provides these 2006 costs as follows:

Harvey Economics evaluated several construction cost indices and employment wage data sources and found the U.S. Bureau of Reclamation (USBR) construction cost indices were the most appropriate to evaluate cost inflation related to the Moffat Project. This was predominantly due to similarities between projects the USBR constructs and tracks and the action alternatives.
For consistency, Denver Water uses the same methodology as Harvey Economics to adjust the action alternatives estimated capital construction costs from 2006 dollars to 2017 dollars in Denver Water's revised Table 2-21 below.

The USBR estimated increase in capital construction costs over the period between 2006 and 2017 is approximately 34.4% for like construction projects (earth dams, concrete dams, pumping plants, and pipelines). This is equivalent to an annual inflation rate of approximately 2.7% for the same period. The 34.4% escalation increase was applied to the 2006 dollar capital construction costs to all five alternatives to develop the 2017 dollar capital construction cost estimates.
To escalate the annual O&M costs from 2006 to 2017 dollars, Denver Water assumed an inflation rate of 3%, which is slightly less than the national long term average rate of 3.2%. The 3% inflation rate is the same as Denver Water's standard discount rate of 3% and the discount rate used by Harvey Economics in 2008 to develop the 80 year present value of O&M. Therefore, an inflation rate of 3% is appropriate and matches historical data and trends.
Applying both escalations, Table 2-21 is revised as follows:

Cost	Alternatives				
	1a	1c	8a	10a	13a
Total Capital Construction Costs[1]	$187.9 M	$394.4 M	$ 486.1 M	$528.1 M	$ 573.0 M
Annual O&M Costs[2]	$0.4 M	$0.8 M	$6.8 M	$8.3 M	$ 5.4 M
Present Worth of Annual O&M (for an 80-year period, discounted at 3 percent)	$ 12.2 M	$25.6 M	$204.8 M	$250.8 M	$163.0 M
Total Present Worth Cost	$200.5 M	$420.8 M	$697.7 M	$787.2 M	$741.4 M

[1] The total capital construction costs were increased by the change in USBR Construction Cost Trends Indexes. The construction cost indices increased by 34.4 % over the 11-year time period between 2006 and 2017.

2 The annual O&M costs were inflated from 2006 to 2017 dollars based on an inflation rate of 3%.

Project Cost (Budget) Estimate
As part of Denver Water's internal budgeting and financing processes, a total Proposed Project cost (budget estimate) was developed for the Proposed Project (Alternative 1a in Table 2-21) to account for all development costs associated with the Proposed Project and includes:

- Estimated capital construction cost
- Permitting cost
- Engineering fees
- Project and construction management fees
- Mitigation, enhancements and other settlement agreement costs

Denver Water's current budget estimate is approximately $380 million, which includes Denver Water's already incurred costs of $22 million – the majority of which were spent on permitting.
Denver Water submitted the $380 million budget estimate in its Application as the Proposed Project cost estimate to best characterize the entire development cost of the Moffat Project and to demonstrate Denver Water's fiscal ability to pay for the Proposed Project, which is a requirement for the Application.

The Denver Water total Proposed Project cost (budget estimate), used in the Application, and the updated EIS capital construction cost are not an "apples to apples" comparison as explained above. The capital construction costs used in the EIS were developed to provide a relative comparison between the five action alternatives using capital construction costs, which Denver Water agrees was a valid approach. The total project costs reflected in Denver Water's budget estimate and the FERC Application is used for a different purpose – to ensure that the Proposed Project budget is established to show the total cost of the construction project.

Internal Denver Water Comment Tracking Number: FORM-12
Comment:

"Tree Removal: Destruction of over 200,000 trees is obviously environmentally damaging. The method of cutting and disposal of the trees is not clear. If burned on site, air pollution will be significant. If hauled out, steepness of terrain and the lack of accessibility to the areas is only via steep, curvy dirt roads so safety is a prime concern"

Response:
The Corps analyzed the impacts associated with tree loss and considered the types of activities associated with clearing and removal in the EIS. This activity is described as part of the Proposed Project in Section 2.2.1 of Exhibit E of the Application, and the impacts are analyzed in various resource sections in Section 3.3 (e.g. see Sections 3.3.12.2 and 3.3.13.2). While the impacts associated with the types of activities for removal of trees are considered, the determination on which methods are preferred to use in certain locations (e.g. use of helicopter versus truck) has not been made definite. Denver Water did include a draft Tree Removal Plan in its Application to form the basis of the environmental analysis of impacts and to promote public comments and ideas to make this determination. This is because Denver Water has proposed in its Application to jointly select the preferred methods of tree removal plan with the relevant agencies and local government to develop a final Tree Removal Plan.

Please also refer to the Application, Summary of Consultation, Attachment E-2, pages 30-31 for Denver Water's response to a similar comment.

Internal Denver Water Comment Tracking Number: FORM-13
Comment:

"Destruction of land for the onsite quarry cannot be mitigated. Sound and dust pollution from quarry operations will have significant impact on residents and wildlife alike."

Response:

In the Settlement Agreement between Denver Water and the Forest Service, the Forest Service agreed that all Proposed Project-related ground disturbing activities, including the quarry, were mitigated through the Settlement Agreement (including 4(e) conditions). Denver Water has also offered mitigation for Proposed Project impacts on lands other than National Forest System lands, which are included in Section 5.1 of Exhibit E in the Application, which includes the development of a Quarry Operations Plan and a Quarry Reclamation Plan for the Osprey Point quarry. Denver Water intends to locate the quarry at Osprey Point where it will be inundated by the new reservoir elevation.

Please also refer to the response to MIR-06 above and to the Application, Summary of Consultation, Attachment E-2, on pages 15-16.

Internal Denver Water Comment Tracking Number: FORM-14
Comment:

"465 acres of inundated land affect the human residents and will eradicate critical habitat for the deer, elk, moose, coyote, bobcat, mountain lion and innumerable bird species that inhabit the area."

Response:

Impacts to wildlife and vegetation were analyzed in the EIS. See Sections 3.3.7 and 3.3.9 of Exhibit E of the Application. Please also refer to Denver Water's proposed mitigation in Section 5.1 of Exhibit E of the Application.

Internal Denver Water Comment Tracking Number: FORM-15
Comment:

"Concern for public safety is a FERC mandate. Impacts to residential traffic hazards along Highway 72 will be significant. DW has not addressed the traffic hazards in any meaningful manner. Even if one ignores the impact of up to 50 truck trips a day in terms of noise and slowing of traffic, the hazards to drivers, pedestrians, motorcyclists and bicyclists is extreme."

Response:

Safety is extremely important to Denver Water at all times at Gross Reservoir and will be a priority during construction of the Proposed Project and as the public continues to use the lands and reservoir for recreation. Denver Water currently has numerous safety plans in place related to Gross Reservoir dam and public recreation of the area. The construction activities will also present safety related issues that will be addressed through best management practices and other measures, such as area closures and traffic management. FERC mandates safety measures and plans through dam safety requirements as well as other authorities under the Federal Power Act, and Denver Water anticipates that the amended license will continue to include safety requirements, some of which will be specific to construction activities and facilities as they get approved by the FERC's regional office. Additionally, Denver Water also anticipates that safety measures will be one of the bases for determinations made in Denver Water's proposed Traffic Management Plan. Denver Water continues to gather information important to making such decisions in the Traffic Management Plan.

Please also refer to the response to BC-09 below and to the Application, Summary of Consultation, Attachment E-2, on pages 33-35.

Internal Denver Water Comment Tracking Number: FORM-16
Comments:

"There is simply not enough water available from involved Western Slope drainages to fill an expanded reservoir most years. Residents and recreationalists will see a barren shoreline with the reservoir less than half full at least half the time. The effects of climate change on the water supply available from the Western Slope is not even considered."

<u>Response:</u>
The EIS evaluates the operations and hydrologic effects of Denver Water's water collection system using its existing water rights that will be used for the Moffat Project. The cumulative effects associated with climate change are also evaluated in the EIS.

As shown in the Application, Attachment B-3, Gross Reservoir is projected to be full, on average, at the end of each month for June, July, and August.

Denver Water continues to evaluate studies and reports related to the effects of drought conditions and climate change, which support the conclusions in the EIS. Observations indicate many regions in the world are warming and in some Colorado locations, snowpack is melting earlier. Looking forward, climate change is expected to influence water systems across the world. Understanding how the changes will come to fruition and how to plan for those changes is a major challenge. Global Climate Models are used to better understand how the climate system functions and what could be expected in the future, but there is significant uncertainty as to how, when, and why the climate will change and what that change will look like at a local scale. Additionally, the uncertainty and range of potential climate change impacts increase significantly as evaluations change from global to local scale examinations. Colorado is particularly challenging to model, and therefore develop skillful climate change projections because of its inland and mid-latitude location and severe geography.

The latest climate change models (BCSD CMIP5) used in the *Climate Change in Colorado* 2014 report, project that winters will be wetter and streamflow may increase in the future for the north-central Colorado headwaters. This is contrary to past projections of the region, which indicated potential increases and decreases in streamflow and little to no change in winter precipitation. As climate science evolves, the uncertainty of climate projections and corresponding implications to basin-scale hydrology is growing, and the range of potential implications is anticipated to increase rather than decrease over time because the physical systems are so complex. Additionally, the methods and data available to translate climate projections into local hydrologic changes add bias and uncertainty to the climate projections rather than increasing predictive skill, and, as Martyn Clark's team at the National Center for Atmospheric Research has shown, different translational approaches produce different results. This lack of actionable, consistent science coupled with the significant uncertainties in climate and hydrology projections and associated impact are too large for the information to add value in local examinations at this point in time. Up-to-date historical hydrology remains the most actionable source of information to inform planning decisions in north-central Colorado.

A 2017 paper by Udall and Overpeck examines the correlation of Colorado River hydrology to the gridded PRISM temperature and precipitation dataset from 2000-2014 at Lees Ferry. The paper recognizes the significance of the lower basin's structural deficit and the 2007 interim operations guidelines to current deficits across the "big river" – the entire Colorado River Basin. While this paper associates early 21st century warming to lower observed flows at Lees Ferry, this same correlation cannot be assumed and has not been observed in the Colorado headwaters. The *Climate Change in Colorado* 2014 and 2007 reports analyzed long-term streamflow records across the state and show two important features. The first is that annual streamflow is highly variable in Colorado, meaning that high and low streamflow conditions occur regularly and have continued to occur despite warming experienced across the globe. The second feature is that there are no statistically significant or even identifiable trends depicting streamflow change. This means average annual streamflow is not increasing or decreasing in Colorado. Furthermore, hydrologic variability is projected to increase across Colorado in the future and there is no consensus as to if or how precipitation will change in the future. Therefore, the conclusions made in the Udall and Overpeck report cannot be pre-assumed for the Colorado headwater and not transferable to headwater basins. Furthermore, there is no evidence to suggest Colorado's reservoirs will not fill in the future. Rather additional storage is necessary to protect human and natural systems by managing increased variability and earlier runoff. Reservoirs are critical mechanisms for stabilizing variations in high and low water years in semi-arid regions like Colorado, ensuring water availability in times of low water years and flood protection in times of high water years.

Fortunately the Upper Basin has a long history of over delivering water from Lake Powell, ensuring the 10-yr running average sufficiently exceeds Colorado River Compact obligations. Reclamation has shown that even under drier hydrology, water is available for Upper Basin use and development. The Upper Basin will continue to manage uses to comply with the compact regardless of future development. Potential impacts to a Colorado River compact call due to a Gross Reservoir expansion are substantially insignificant, particularly in comparison to the magnitude of the big river challenges.

Denver Water is obviously vitally concerned about the impacts of climate change on water resources. Unfortunately, climate model projections are not predictions of future conditions. At best, they can be used to understand possible ranges of future conditions and to assist in developing system flexibility. At this point in time, historical hydrology is still the best planning tool for water resources decisions in our region. There is no actionable science that would justify a conclusion that the enlarged Gross Reservoir will not fill as necessary to produce the intended 18,000 acre-feet of yield.

Please also refer to the Application, Summary of Consultation, Attachment E-2, on page 30.

Internal Denver Water Comment Tracking Number: FORM-17
Comment:

> ***"Visitor numbers to Gross Reservoir are significant. The disruption of recreation activities due to construction, years of blasting, tree removal, and traffic interruptions will be huge. The loss of scenic areas, the drowning of Forsythe Falls, and closures to boating, fishing, hiking, picnicking and other visitor activities have not been addressed. A public review of DWs yet-to-be written plan for how they will address the impact on recreation should be conducted before the project is finalized and the FERC license amended."***

Response:
Denver Water's Application a final Recreation Management Plan Addendum ("RMP Addendum"). This document explains the recreation facilities that will need to be relocated because of inundation. The document also shows where Denver Water will be placing the relocated recreation facilities. The RMP Addendum was included in the Draft Application, and the consultation process required by the license to amend the current Recreation Management Plan is described at the beginning of the RMP Addendum. Therefore, to be approved in FERC's decision on the Application, Denver Water submitted a final RMP Addendum that describes how and where the recreation facilities will be relocated. The EIS analyzed all ground disturbing impacts associated with the Proposed Project, which includes the construction and relocation of these existing recreation facilities. Please refer to Denver Water's proposed mitigation in the Application, Exhibit E, Section 5.1.

Please also refer to the Application, Summary of Consultation, Attachment E-2, on pages 31-33.

Internal Denver Water Comment Tracking Number: FORM-18
Comment:

"Earthquake potential due to a larger reservoir had not be analyzed. DW states that these studies will be conducted during the design and construction phase of the project. This research needs to be done prior to the issuance of permits to that the approving agencies can base their decisions on a complete picture."

Response:
The EIS analyzed impacts of the Moffat Project on seismicity and geologic hazards. See the Application, Exhibit E, Section 3.3.5.1. Gross Reservoir has not caused reservoir induced seismicity in all the 60 years of operation. There are no identified active faults within the reservoir or project area, and reservoir induced seismicity is not an identified failure mode for the facility. As such the probability of seismic activity due to an increased reservoir is extremely low to nonexistent. Regardless, Denver Water intends to follow the FERC's Engineering Guidelines for the Evaluation of Hydropower Projects, including Chapter 13 – Evaluation of Seismic Hazards (Revised Draft Version), to design the dam. In addition, an independent Board of Consultants will review the seismic hazard identified for the facility and the associated dam design.

<u>*Teagan Blakey Comment Letter*</u>:
Internal Denver Water Comment Tracking Number: TB-01 through TB-06
Comments and Letter Reference: Page 1, Paragraph 2, 3, 4, 5, 6, 7

> ***"The exchange of the Toll Property Lands in Gilpin County does not mitigate the resource values that DW and the Forest Service (FS) admit will be 'permanently lost on NFS lands due to additional inundation of approximately 280 acres' and 'the effects of the establishment of the quarry, construction of the saddle dam, and any staging and stockpile areas on NFS land which cannot be otherwise mitigated.'"***
>
> ***"The affected lands in question around the Reservoir are located in Boulder County. Substituting lands in a different county is not acceptable mitigation."***
>
> ***"The Toll Property Lands do not mitigate he damage to scenic values surrounding the Reservoir, such as the inundation of Forsythe Falls, which has been described as 'a gem of Boulder' by an award-winning photographer."***
>
> ***"The Toll Property Lands do not mitigate the sound impacts on wildlife, or residents during the proposed 3 year on-site quarry operation, or the 24 hour concrete plant for that measure."***
>
> ***"The Toll Property Lands do not replace the loss of 465 acres of habitat around the reservoir for the same wildlife being displaced."***
>
> ***"Simply transferring ownership of undeveloped land, such as the Toll Property, does not compensate for the permanent loss and destruction of other such undeveloped land around the Reservoir."***

<u>Response</u>:
The Toll Property is proposed to offset those impacts caused by inundation of lands and as mitigation for effects of the establishment of the quarry, construction of the saddle dam, and any staging and stockpile areas on NFS land which cannot be otherwise mitigated. Please refer to the Application, Exhibit E, Section 5.1 for the mitigation proposed to offset other Proposed Project impacts, including construction impacts.

Denver Water is proposing to FERC that the purchase and conveyance to the Forest Service of 539 acres of property (the "Toll Property") serves as mitigation to offset impacts to resources caused by inundation of 456 acres within the FERC Project Boundary. The Forest Service agreed that the purchase and transfer of the Toll Property mitigates the impacts of inundation on resources on the 280 acres of National Forest System lands.

The Toll Property is in the same watershed as Gross Reservoir (South Boulder Creek) and is adjacent to an existing wilderness area (James Peak Wilderness) on National Forest System land. The preservation (through its addition to the National Forest System) includes 43 acres of wetlands, 253 acres of riparian habitat, and over 5.5 miles of stream (4.2 miles perennial). Additionally, the Colorado National Heritage Program (CNHP) classifies the Toll property as "very high biodiversity." In comparison, the Proposed Project will inundate 280 acres of Forest Service land, 2 acres of wetlands, 4 acres of riparian habitat, and 5.7 miles of stream (4.2 miles perennial). Additionally, only a small portion of the 262 acres of "High Biodiversity Significance", per CNHP, and none of the 65 acres of "Very High Biodiversity Significance" will be impacted by the Proposed Project.

The Toll Property contains scenic vistas and opportunities for solitude, remote high elevation hiking and backpacking opportunities and legal appropriate non-motorized access to the James Peak Wilderness and Continental Divide Trail.

The Toll Property also contains jurisdictional wetlands and riparian areas that will be protected through the Forest Service's management of these lands.

Internal Denver Water Comment Tracking Number: TB-07 and TB-08
Comments and Letter Reference: Page 1, Paragraph 8, Sentence 1 and Sentence 2

"The disruption of recreation activities on and around the Reservoir for at least 4 years due to construction, years of blasting, tree removal, and traffic interruptions will be extreme."

"Yet after all of this there will be no increase in recreational benefit. 'At the end of construction, recreation opportunities will be similar to what currently exists at Gross Reservoir' (Denver Water). However Denver Water neglects to mention the huge loss of scenic areas, the drowning of Forsythe Falls, and popular hiking trails among others that will no longer exist for recreation."

<u>Response</u>:
The EIS analyzes the impacts of the Moffat Project to recreation. Refer to the Application, Exhibit E, Section 3.3.15 for this analysis and the mitigation proposed by Denver Water in Section 5.1 of Exhibit E. Please also refer to the Application, Summary of Consultation, Attachment E-2, pages 28-31. Also refer to the response to FORM-17 above for an explanation of the RMP Addendum regarding relocated recreation facilities. .

Internal Denver Water Comment Tracking Number: TB-09
Comment and Letter Reference: Page 1, Paragraph 8, Sentence 5

"A public review of DWs yet-to-be written plan for how they will address the impact on recreation must be conducted if and before the project is finalized and the FERC license amended."

<u>Response</u>:
Please refer to the Application, Attachment A-1 of Exhibit A, and to the response to FORM-17 above.

Internal Denver Water Comment Tracking Number: TB-10
Comment and Letter Reference: Page 1, Paragraph 9

"There is simply not enough water available from the Western Slope drainages involved to fill and expanded reservoir most years. Residents and recreationalists will see a barren shoreline with the reservoir less than half full at least half the time. The effects of climate change on the water supply available from the Western Slope is not even considered"

<u>Response</u>:
Please refer to the response to FORM-16 above.

Internal Denver Water Comment Tracking Number: TB-11 thru TB-17
Comments:

"Total water supply will equal demand in 2022. No numeric data are given to support this. The purpose and need for the Moffat Project based on projections of water supply and demand cannot be validated. The demand model used is faulty."

"Per DWs own 2015 Comprehensive Annual Financial Report, treated water consumption is decreasing as population is increasing."

"All calculations of demand are based on unrestricted use of water during a drought which is not realistic."

"The alternative analysis required by NEPA and the Clean Water Act is highly flawed."

"Criteria used by the Army Corps of Engineers to identify acceptable alternatives (the selection must deliver water to the Moffat Collection System) for study was too narrow, hence the Least Environmentally Damaging Practicable Alternative was not appropriately evaluated."

"Consequences of not increasing supply to the Moffat Treatment Plant are speculative. No quantitative analyses are provided."

"Problem to be solved is not lack of stored water – it is lack of a conveyance system. The solution to getting water north is not by compensating with a bigger reservoir, but by building conveyance systems that bring raw water directly to Moffat Treatment Plant."

Response:
Please refer to the Denver Water's response to NEPA and CWA related comments above.

Internal Denver Water Comment Tracking Number: TB-18 and TB-19
Comments:

"The EIS estimates a total cost of $139.9 million while the FERC application estimates $364.1 million. The higher figure can be corroborated so the alternatives were evaluated based on faulty data."

"Recent upgrades to Moffat plant enable it to handle agricultural / reusable water. All cost estimates that included the costs to build an advanced water treatment plant are now inaccurate as upgrades are no longer needed."

Response:
Please refer to response to FORM-10 above.

Boulder County Comment Letter:
Internal Denver Water Comment Tracking Number: BC-01
Comment and Letter Reference: Page 1, Item 5

> ***"Boulder County has been interested in, and an active participant in the review of, Denver Water's proposal to expand Gross Reservoir since the project was first publicly proposed by Denver Water. In 2003, in connection with Denver Water's proposal, Boulder County submitted comments to the U.S. Army Corps of Engineers (the "Corps") related to its scoping of the Environmental Impact Statement ("EIS") for the project. In 2008, Boulder County sent comments to Denver Water after reviewing Denver Water's Pre-Application Document in relation to its permit amendment application to the FERC. In 2010, Boulder County submitted combined comments to the Corps and the FERC on the Draft EIS and Draft FERC License Amendment Application. In 2014, Boulder County submitted two rounds of comments upon the Corps' Final EIS for the project. Because the Record of Decision on the Final EIS has still not been issued, and because the FERC is relying upon the Corps' EIS for its environmental review of Denver Water's Application, Boulder County believes those comments to be applicable to the FERC's review of the Application and has attached a copy of its 2014 comments to the Corps to this Motion to Intervene. See Exhibit A (attached June 5 and July 14, 2014 comment letters to Corps). Finally, Boulder County has maintained and continues to maintain that Denver Water must obtain required County permits before it undertakes its project."***
>
> Response:
> Denver Water agrees that specific construction activities (e.g. the construction of the materials testing lab) will require building permits and/or road use permits from Boulder County prior to construction. Denver Water plans to acquire applicable local permits.
>
> Denver Water is requesting Boulder County to engage in settlement discussions through the Dispute Resolution Service offered by FERC to settle any issues, included but not limited to permitting, that Boulder County believes have not been satisfied by the information contained in Denver Water's application. Please see Attachment 3 – Boulder County Commissioners Letter for a copy of the May 8, 2017 letter sent to Boulder County from Denver Water, included with this response letter. Through the avoidance, minimization, mitigation and enhancement commitments offered in the Application, Exhibit E, Section 5.0, Denver Water has addressed how the temporary impacts associated with construction activities will be mitigated. Denver Water has proposed ways in which Boulder County will be actively involved to develop best practices for specific elements and activities during the construction phase. As provided in Section 5.0 of Exhibit E of the Application, Denver Water seeks Boulder County's assistance in the development of the Quarry Operations Plan, the Quarry Reclamation Plan, the Traffic Management Plan, and the Tree Removal Plan, where applicable requirements under county ordinances and codes will help dictate construction practices and protocols (e.g. traffic controls, noise monitoring, preferred methods for tree removal).

Internal Denver Water Comment Tracking Number: BC-02
Comment and Letter Reference: Page 2, Item 6

> ***"Despite the extensive record that has been created related to the EIS and Denver Water's draft and final Application to the FERC, Denver Water's Application to the FERC is deficient because it relies upon stale data and data that are factually inaccurate. Further, it fails to adequately develop and consider several issues that are of critical importance to Boulder County and its citizens. These issues must be resolved before the FERC acts upon Denver Water's Application."***

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: BC-03
Comment and Letter Reference: Page 2, Item 7

"When Denver Water first proposed its project to expand Gross Reservoir, it anticipated that it would complete the project in 2016 and that 2016 was the first year that, without the expansion, its customers would experience water shortages. The project has not yet commenced construction but, despite experiencing years of drought over the past 15 years, Denver Water has not seen any water shortages. This lack of a predicted water shortage occurred because, despite a rapidly growing customer base, Denver Water's customers are using less water, not just per person, but as a whole. Denver Water is to be lauded for the water conservation initiatives it has implemented, but the fact that it can serve more customers with less water means that the assumptions made in the EIS as justification for the need for this project are incorrect. Boulder County asks that FERC require a new analysis of Denver Water's demand and whether the preferred alternative can be properly categorized as the least environmentally damaging way to meet Denver Water's water supply needs. Alliance to Save the Mattaponi v. U.S. Army Corps of Engineers, 606 F.Supp. 2d 121, 130 (D.Colo. 2009) (Agency performing EIS must take a new look at alternatives if there is evidence of reduced need and higher cost for a proposed reservoir project.) Denver Water should be required to achieve greater security in its water supply by adopting increased water conservation measures before it is permitted to de-water streams on the West Slope and in Boulder County."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: BC-04
Comment and Letter Reference: Page 2, Item 8

"As set forth in Boulder County's July 1, 2014, comments to the Corps, the EIS is deficient because it does not address the anticipated impacts of climate change upon the projected future streamflows in the Upper Colorado River Basin. Denver Water has alleged that, because there is uncertainty regarding what these impacts will be, it is appropriate to ignore the impact that climate change may have upon the availability of water supply to fill Gross Reservoir in the event that the dam and reservoir are enlarged. Denver Water cites no law to support this approach and it is contrary to federal guidance related to the consideration of the impacts of climate change in the National Environmental Policy Act process. (See August 1, 2016, Memorandum for Heads of Federal Departments and Agencies, from Christina Goldfuss, Council on Environmental Quality, which finds that '[f]ocused and effective consideration of climate change in NEPA reviews will allow agencies to improve the quality of their decisions.')"

Response:
Please refer to Denver Water's response to NEPA and CWA comments above and to the response to FORM-16 above.

Internal Denver Water Comment Tracking Number: BC-05
Comment and Letter Reference: Page 3, Item 9

"The analysis of climate change impacts should focus on those aspects of the human environment that are impacted by both the proposed action and climate change. Climate change can make a resource, ecosystem, human community, or structure more susceptible to many types of impacts and lessen its resilience to other environmental impacts apart from climate change. This increase in vulnerability can exacerbate the effects of the proposed action. For example, a proposed action may require water from a stream that has diminishing quantities of available water because of decreased snow pack in the mountains, or add heat to a water body that is already warming due to increasing atmospheric temperatures. Such considerations are squarely within the scope of NEPA and can inform decisions on whether to proceed with, and how to design, the proposed action to eliminate or mitigate impacts exacerbated by climate change." Id. p. 21. (emphasis added)"

Response:
Please refer to Denver Water's response to NEPA and CWA comments above and to the response to FORM-16 above.

Internal Denver Water Comment Tracking Number: BC-06
Comment and Letter Reference: Page 3, Item 10

"The scientific literature shows a consensus that climate change will likely cause a future decrease in streamflows in the Upper Colorado River Basin because, even in the event that there is an overall future increase in precipitation, more precipitation will fall as rain, rather than snow, and there will be more evapotranspiration. See for e.g., Lukas, J., Barsugli, J., Rangwala, I., and Wolter, K., Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation (2014); Gordon, E., and Ojima, D., Colorado Climate Change Vulnerability Report (2015); Ficklin, D., Stewart, I., and Maurer, E., Climate Change Impacts on Streamflows and Subbasin-Scale Hydrology in the Upper Colorado River Basin (2013); as well as the articles cited in Boulder County's 2014 comments to the Corps. If there is less water in the tributaries of the Upper Colorado River and South Boulder Creek, there will be less water available for Denver Water to divert into Gross Reservoir. Denver Water has defined its purpose and need for the expansion of Gross Reservoir as to develop 18,000 acre feet of new, firm yield to the Moffat Treatment Plant and that it can reach this "firm yield" only if it can divert at least this much in 75% of the years and if it can have a "savings account" of four times that figure. If the scientific literature is correct, Denver Water will be unable to meet these standards it has established as the underpinning of its proposed project and the purpose and need of the project cannot be met. If the preferred alternative fails NEPA's most basic test of viability, the proposed alternative must be rejected. Boulder County encourages the FERC to perform a robust review of the available scientific literature and take a hard look at whether the EIS's ignoring the anticipated impacts of climate change upon the ability for Denver Water to fill Gross Reservoir in the future is appropriate or whether the EIS needs to be supplemented to study these impacts in earnest."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above and to the response to FORM-16 above.

Internal Denver Water Comment Tracking Number: BC-07
Comment and Letter Reference: Page 3, Item 11

"In its application to the FERC, Denver Water has included minimal information and analysis related to the impacts of its proposed project on the local transportation system. Boulder County is the

local government responsible for the operation and maintenance of many of the roads that will be affected by the project as proposed. To evaluate transportation impacts and adequately determine

potential mitigation measures, a much more detailed analysis of the impacts of construction-related traffic must be performed before the FERC issues any permits to Denver Water. Further, any permit issued must include binding mitigation measures to protect the health and safety of area residents."

Response:
The EIS analyzed the impacts of the Moffat Project on transportation. Please refer to the Application, Exhibit E, Section 3.3.12, and to Section 5.1 of Exhibit E for the proposed mitigation. Please also refer to the response to BC-01 above.

Internal Denver Water Comment Tracking Number: BC-08
Comment and Letter Reference: Page 4, Item 12

"In Section 2.2.12.1 of its application, Denver Water references a regional transportation plan (Metro Vision 2030 Plan) that is 10 years out of date, having been replaced by the 2040 Regional Transportation Plan in 2015. The application's financial data related to the Colorado Department of Transportation are also almost 10 years out of date. In Table 3.3.12-1, Denver Water discusses plans for the Colorado Department of Transportation to expand two state highways Denver Water plans to use to bring workers and supplies to and from the project site (SH 72 and SH 93) from 2 lanes each to 4 lanes each. However, there are no plans, nor have there ever been, to expand either of these state highways. These obvious errors indicate that the other factual underpinnings of the Denver Water application are likely unreliable."

Response:
Denver Water notes that there is no Section 2.2.12.1 in the Application. Denver Water continues to investigate opportunities to reduce the traffic burden on public roads and highways. For example, since the release of the Final EIS, Denver Water has found it feasible to produce all aggregate on site using the quarry, as analyzed in the EIS. This will reduce the traffic volume by 16,900 trucks. This reduction represents a significant minimization of the EIS impacts associated with truck traffic. Denver Water looks forward to developing the final Traffic Management Plan with input from Boulder County, Jefferson County, and local residents. In developing that plan, the current CDOT plans, estimates, and data should be used. However, Denver Water believes the use of the regional government growth plans and CDOT data available at the time of the development of the EIS was reasonable and adequate and does not alter the EIS assessments of impacts of the Moffat Project. This information is presented in the Application, Exhibit E, Section 3.3.12. Denver Water believes there are opportunities to further reduce the traffic burden by designating hauling days and times, reducing worker traffic by use of carpools or shuttles, and through intelligent traffic solutions such as variable message boards and mobile applications. Denver Water seeks input from Boulder County on the use of these measures and other ideas during the development of the Traffic Management Plan proposed by Denver Water.

Internal Denver Water Comment Tracking Number: BC-09
Comment and Letter Reference: Page 4, Item 13

"In its application, Denver Water refers to a traffic study that it commissioned in the summer of 2013. The people who live in the vicinity and monitored the study testified to the Board of County Commissioners at a public hearing in 2014 that the trucks were only half-way that they did not travel during commuter traffic, that they could not maintain a speed close to the speed limit, and that the trucks repeatedly had to cross double yellow lines in order to navigate turns. It is essential that a new

traffic study be conducted, by an objective third party, that replicates the actual conditions upon which truck traffic will be conducted (full trucks, travelling both up and down Coal Creek Canyon,

during the times of day when trucks will actually be travelling, and including an analysis of speeds travelled, cueing behind trucks, and whether, and how often, trucks either crossed the centerline of the road and/or violated state and local noise limits). After the prior study, Denver Water told Boulder County that the study had shown that the intersection of SH 72 and Gross Dam Road would need to be re-engineered, yet there is nothing in Denver Water's application to the FERC that refers to this required change."

Response:
The EIS analyzed the impacts of the Moffat Project on transportation. Please refer to the Application, Exhibit E, Section 3.3.12. In the Application, Summary of Consultation, Attachment E-2, on pages 33-38, Denver Water also describes and attaches the detailed traffic studies that Denver Water has conducted to learn more about how the roads will be used during construction. Included in that information are the studies conducted in 2009 and 2012 to review the roads and assess the ability of haul trucks to navigate the roads leading to Gross Reservoir. These studies also reviewed turn-out locations and practicality, as well as hauling alternatives. It should also be noted that these studies also contemplated the use of trucks for the material associated with the tree removal (tree debris and slash). As Boulder County points out, Denver Water conducted a mock haul study in August 2013 to deliver road base material to Gross Reservoir, utilizing the same roads that would be used to deliver materials for the Proposed Project. This information was available on Denver Water's website during consultation. Denver Water has a new Moffat Project website at www.GrossReservoir.org, and viewers can watch the short videos that describe the study and its results, including acknowledgement that road improvements will be needed. The study identified issues that will need to be addressed in consultation with CDOT, Boulder County, and affected community members. Denver Water is committed to ongoing dialogue on transportation safety issues. With regard to the weight of the trucks in the study, 9 of the 10 trucks were loaded with road base material available at Denver Water's shop complex, producing a gross vehicle weight of 66,000 to 78,000 lbs. when the average tractor trailer weight of 32,000 lbs. is included. Of the 8 trucks that pulled loads to Gross reservoir (one truck went uphill empty, and one full truck broke down), 6 dumped their loads, and 2 returned down the hill with full loads. As a result, there were 6 loads of fill at the reservoir, not 10 loads as the commenter might have expected.

Additionally, in 2015, Denver Water hired a consultant to develop an example of a traffic control plan, Attachment 4 – *Gross Dam Reservoir Expansion – Traffic Control Plan (December 2015).* It has been Denver Water's intent not to submit a final Traffic Management Plan to FERC without engaging the appropriate stakeholders. The purpose of these studies, including the draft Traffic Control Plan, is to aid in the collaborative process to help further ideas and make final a jointly-developed Traffic Management Plan, as proposed by Denver Water in its Application. The 2015 Traffic Control Plan was developed for the purpose of starting the discussions in that collaborative process as soon as Denver Water receives an order from FERC amending its license, assuming that FERC accepts Denver Water's proposed mitigation to jointly develop a Traffic Management Plan. Denver Water is including the 2015 Traffic Control Plan in this response to demonstrate its continued commitment and investment towards developing the best Traffic Management Plan along with the relevant agencies, counties and the local community. Additionally, in the Application, Denver Water did not include a proposal to address whether the intersection of SH 72 and Gross Dam road would be re-engineered or if flaggers could be used to control traffic during truck hauls. Decisions like these are what Denver Water intends to answer through a collaborative development of the Traffic Management Plan. Additionally, road use approvals, as mentioned above, may be required and will be acquired, depending on the decisions made for traffic management and control.

Internal Denver Water Comment Tracking Number: BC-10
Comment and Letter Reference: Page 4, Item 14

"The EIS and the FERC application include disparate numbers used for the number of trucks that will be used to bring construction materials to the project site, largely dependent upon how much aggregate is mined on site. The application also ignores the impacts that will be caused by workers driving to and from the project site each day. Denver Water should be required to develop a plan for shuttling workers to and from the job site to relieve traffic congestion and for increased safety and a reduction in vehicle miles travelled. Because trucks traveling to the work site will be in part on Boulder County's roads, and this 5 year construction project will have major impacts on Boulder County roads and the citizens who live in the vicinity of the project, any permit issued by the FERC must include specific conditions of approval related to which roads will be used, for which purposes, at what times of day, with what necessary improvements, and with what maintenance responsibilities."

Response:

The EIS evaluated the impacts of transportation and included workers commuting to the site. See the Application, Exhibit E, Section 3.3.12.2. For both traffic reduction and safety, Denver Water is interested in including in proposed, jointly-developed Traffic Management Plan a commitment to reduce the amount of vehicles on the road by providing a shuttle for workers. This commitment was offered in the Intergovernmental Agreement with Boulder County that did not get approved by the Boulder County Commissioners. As proposed in the Application, Exhibit E, Section 5.1, Table 5.1-1, a jointly developed Traffic Management Plan will include commitments for travel times, roads used or restricted from use, road maintenance, road improvements and other measures to minimize associated impacts from trucks (e.g. noise, odors, dust), as well as safety measures.

Internal Denver Water Comment Tracking Number: BC-11
Comment and Letter Reference: Page 4, Item 15

"Tree removal will also have significant transportation and environmental impacts. Denver Water has estimated that, to expand Gross Reservoir, it will need to remove more than 200,000 trees greater than 4" in diameter. Yet, despite the fact that this will require thousands of truck trips to haul these trees away from the project site, Denver Water has not created a plan for how it will remove the trees, upon what roads, to what destination/s, or what it will ultimately do to dispose of these trees. Denver Water has stated that it would like to find a market for as many of these trees as possible but Boulder County's experience in performing forestry management in the area is that there is no viable market in the vicinity for wood products derived from the small-dimensioned pine and fir trees that will be removed."

Response:

Please refer to the response to FORM-12 above. In addition to the EIS evaluation of air quality impacts associated with all elements of the construction of the Moffat Project (including tree removal and disposal), the impacts associated with transportation also included the tree removal process. Refer to the Application, Exhibit E, Sections 3.3.12.2 and 3.3.13.2. Denver Water included tree removal in the truck studies it conducted to review the use of roads and alternatives for hauling, as described in the response to BC-09 above. For those studies, please refer to the Application, Exhibit E, Attachment E-8 *(Borrow Haul Study – January 2009 and Final Borrow Haul Study Alternative Analysis – December*

2012). Additionally, in its Application, Denver Water did in fact include a draft tree removal plan that forms the basis of the impact analysis and will be used to make decisions in the proposed jointly-

developed Tree Removal Plan. See the Application, Exhibit E, Attachment E-6 (*Gross Reservoir Tree Removal Plan for Pool Enlargement- July 2008 and Supplement to Gross Reservoir Tree Removal Plan for Pool Enlargement – October 2008*) for that draft Tree Removal Plan and Section 5.1 of Exhibit E for a description of the proposed development of a final Tree Removal Plan.

Internal Denver Water Comment Tracking Number: BC-12
Comment and Letter Reference: Page 5, Item 15

"How these trees are removed, upon what roads, and how they will be disposed of are of tremendous importance to Boulder County and to its citizens. Denver Water's application says that tree harvesting and removal will require use of several existing unpaved and four-wheel drive roads around Gross Reservoir. However, Denver Water has failed to identify which roads it plans to use. Certain county roads (Flagstaff Road, Magnolia Road and others) are windy with low volume residential traffic and would be inappropriate for use by trucks hauling trees. In addition, it may not be possible to safely navigate SH 72 with trucks full of trees. These heavily laden trucks will cause damage to the roads and present safety concerns for road users. Denver water must identify who will responsible for maintaining these roads during and after the project is over. Denver Water has proposed that, after it receives its permit from the FERC, it will consult with Boulder County about how it will remove its 200,000 trees. This proposed consultation after its project has been approved is anemic and unacceptable to Boulder County. The FERC doesn't currently have the information upon which these decisions can be made; it will require additional study. Boulder County's concerns need to be studied, addressed, and resolved prior to issuance of any permits by the FERC."

<u>Response</u>:
Please refer to the response to BC-11 above.

Internal Denver Water Comment Tracking Number: BC-13
Comment and Letter Reference: Page 5, Item 17

"Boulder County is also concerned about the climate change and greenhouse gas impacts of tree removal. Federal agencies are encouraged to use the incremental contribution of a proposed action as a proxy for assessing the proposed action's potential impacts on climate change (See August 1, 2016, Memorandum for Heads of Federal Departments and Agencies, p. 10). If more than 200,000 trees are burned, the carbon impact of the tree removal may exceed the carbon impact of the construction of the remainder of the project. The FERC should mandate that Denver Water study the greenhouse gas impacts of various methods of tree removal and disposal and mandate that Denver Water create biochar from the trees that are removed or pursue some other solution that doesn't result in the release of so much carbon into the atmosphere."

<u>Response</u>:
Please refer to the response to BC-11 above. Denver Water did evaluate emissions, including greenhouse gas emissions (carbon footprint analysis) of truck hauling (including timber) in response to comments from Boulder County. Please refer to the Application, Exhibit E, Attachment E-8 (*Final Borrow Haul Study Alternative Analysis – December 2012*). Additionally, as described in the EIS and in the Application, Denver Water anticipates that air quality permits from the Colorado Department of Public Health and Environment may be necessary for various construction activities, which may include tree removal activities, depending on the methods ultimately selected. These permits will be acquired

by Denver Water or its contractor. Nonetheless, the EIS and Application considered the air quality effects anticipated from the tree removal process.

Internal Denver Water Comment Tracking Number: BC-14
Comment and Letter Reference: Page 5, Item 18

"Denver Water's application proposes that its recent purchase and transfer of a portion of the Toll family property to the United States Forest Service be its sole effort to mitigate the environmental impacts of constructing the project and inundating more than 450 acres of national forest. While this acquisition, a part of a much larger multi-party conservation initiative, is a positive step, it will only maintain the status quo for this property, and protecting the watershed above Gross Reservoir from potential future development directly benefits Denver Water's future operations. The Toll acquisition, and the rest of Denver Water's application, does nothing to address other environmental impacts of the project, such as increased mercury loading in the reservoir due to methylation or any of the impacts of project noise, dust, and light pollution that will plague Gross Reservoir's neighbors for the 5 years that the project will be built. Denver Water must be required by the FERC to avoid these environmental impacts to the greatest degree possible and mitigate them to the degree they cannot be avoided."

Response:
Please refer to the response to TB-01 through TB-06 above. Please also refer to the Application, Exhibit E, Table 5.1-1 where Denver Water's complete mitigation proposed to offset the impacts of the Proposed Project is described. The Toll Property is proposed to offset the impacts to resources from inundation and as mitigation for the effects of the establishment of the quarry, construction of the saddle dam, and any staging and stockpile areas on NFS land which cannot be otherwise mitigated.

Internal Denver Water Comment Tracking Number: BC-15
Comment and Letter Reference: Page 5, Item 19

"In deciding whether to issue any license under this subchapter for any project, the Commission, in addition to the power and development purposes for which licenses are issued, shall give equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality." 16 U.S.C.A. § 797(e). Because this project, if constructed, will have longstanding impacts upon Boulder County's citizens and the environment, it is critical that the FERC provide a hard look at the project's impacts and that the FERC determine that the project is the least environmentally damaging alternative that meets the purpose and need Denver Water seeks to address with the project. This requires further study and analysis by the FERC to look at the issues that have not yet been adequately addressed. If any permit is granted by the FERC, it must contain binding mitigation measures that protect the health and safety of Boulder County residents, preserve and protect the natural environment, and represent the least environmentally damaging way to construct the project."

Response:
Denver Water believes the Application includes all the information, analysis and mitigation necessary for the FERC to base its decision for approval of the Proposed Project.

Marian Trowbridge Comment Letter:
Internal Denver Water Comment Tracking Number: MT-01
Comment and Letter Reference: Page 1, Paragraph 1, Sentence 1 and 2

> ***"Denver Water needs to do more in educating and requiring a different attitude towards water use. They (actually Colorado) should require low water grass or native plants as landscape in new housing."***
>
> Response:
> Please refer to the Application, Summary of Consultation, Attachment E-2, on pages 38-40 for Denver Water's response to a similar comment.

Internal Denver Water Comment Tracking Number: MT-02
Comment and Letter Reference: Page 1, Paragraph 1, Sentence 3

> ***"As the weather is perceived to be changing, just making the a dam higher won't solve long term problem."***
>
> Response:
> Please refer to the response to FORM-16 above.

Internal Denver Water Comment Tracking Number: MT-03
Comment and Letter Reference: Page 1, Paragraph 1, Sentence 4

> ***"Denver Water needs to be inventive in using the water it has for better use and reuse."***
>
> Response:
> Please refer to the response to MT-01 above.

Internal Denver Water Comment Tracking Number: MT-04
Comment and Letter Reference: Page 1, Paragraph 1, Sentence 5 and 6

> ***"There needs to be water restrictions for Denver Water and those cities they rent water. At a house, apartment, or business closing, the buyer should be made to see movie and sign a statement of what water savings they are promising to practice as being a responsible owner."***
>
> Response:
> Please refer to the response to MT-01 above.

Internal Denver Water Comment Tracking Number: MT-05
Comment and Letter Reference: Page 1, Paragraph 2, Sentence 2

> ***"The noise will carry for miles and be constant."***
>
> Response:
> Please refer to the response to MIR-05 above and to the Application, Summary of Consultation, and Attachment E-2 on pages 17-18.

Internal Denver Water Comment Tracking Number: MT-06
Comment and Letter Reference: Page 1, Paragraph 2, Sentence 3

"The fish will be killed and should be utilized for food of homeless but will probably be wasted."

Response:
The EIS analyzed the impacts to wildlife and aquatic resources. See the Application, Exhibit E Section 3.3.11.2

Internal Denver Water Comment Tracking Number: MT-07
Comment and Letter Reference: Page 1, Paragraph 2, Sentence 4

"The water fowl and other wild animals will be disrupted of their habitat."

Response:
Please refer to the response to FORM-14 above.

Internal Denver Water Comment Tracking Number: MT-08
Comment and Letter Reference: Page 1, Paragraph 2, Sentence 5

"Having so many huge trucks on a winding mountain road built for cars is dangerous for not only the truck drivers but the residents from truck debris and lack of space on the road."

Response:
Please refer to responses to FORM-15, BC-09 and BC-10 above.

Internal Denver Water Comment Tracking Number: MT-09
Comment and Letter Reference: Page 1, Paragraph 3, Sentence 1

"Denver needs to exhaust all other possibilities like finding alternatives like conveyance systems."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

David Bahr Comment Letter:
Internal Denver Water Comment Tracking Number: DB-01 through DB-05
Comments:

> ***"Among the certain impacts of climate change on Gross Reservoir are reduced snowpack and water availability, longer droughts, greater evaporation of water, and faster and earlier runoff at higher volumes that could not be captured with the Moffat Tunnel Collection system."***
>
> ***"The latest peer-reviewed climate assessments (e.g., Udall and Overpeck, 2017) indicate that water in the Colorado River Basin (from which Gross Reservoir is filled) will decrease by 20 to 30% by mid-century and 35 to 55% by the end of the century. Even the most conservative value of 20% at mid-century will make it impossible to fill an enlarged Gross Reservoir, let alone the existing reservoir."***
>
> ***"It will also be impossible to meet multi-state and multi-national downstream water commitments, and therefore political realities will make it even harder to fill the reservoir. With reductions in stream flows expected to be at the even higher values of 35% to 55%, it is foolish to build an enlarged reservoir."***
>
> ***"Like other reservoirs in the Colorado River Basin, the existing Gross Reservoir will remain unfilled in most years and an enlarged reservoir cannot be filled."***
>
> ***"With reductions from climate change but no reduction in downstream commitments, the total water in the Denver Water system will be limited. To fill an enlarged Gross Reservoir, Denver Water will have to forgo filling another reservoir in their collection system."***
>
> Response:
> Please refer to Response to FORM-16 above.

Internal Denver Water Comment Tracking Number: DB-06
Comment:

> ***"(In addition to being a shell game, moving water to an enlarged Gross Reservoir is an engineering impossibility because the Moffat Treatment Plant does not have the capacity to treat the additional water, and the Moffat Tunnel does not have the capacity to safely capture the shorter-duration and higher-volume runoff in the Fraser River.)"***
>
> Response:
> Please refer to Denver Water's response to NEPA and CWA comments above and to Chapter 1 of the EIS for a thorough description and explanation of the purpose and need of the Moffat Project.

TEG Section I Comment Letter:
Internal Denver Water Comment Tracking Number: TEG-01-01
Comment and Letter Reference: Page 4, Paragraph 2, Sentence 2

> ***"In the unique case of the Moffat Collection System Project, Denver Water is applying to FERC for a license amendment, not because its hydroelectric generation will be changed, but because the project has major effects on the environment around Gross Reservoir and on the Western Slope water drainages."***
>
> Response:
> Indeed, Gross reservoir and dam, as well as the surrounding lands within the licensed Project Boundary are subject to FERC's authority under the Federal Power Act and require FERC's approval before major modifications can be made.

Internal Denver Water Comment Tracking Number: TEG-01-02
Comment and Letter Reference: Page 4, Paragraph 4, Sentence 1

> ***"Denver Water claims that FERC is not concerned with project effects on the Western Slope because such effects are outside its jurisdiction, and refers to previous relicensing to document this: "The scope of analysis for the Proposed Project is limited to the FERC's jurisdiction under the Federal Power Act. For the information provided in this application, Denver Water refers to the scope of the current license and the analysis conducted during the relicensing of Gross Reservoir" Vol. III, page 26. and quotes from FERC re the 2001 re-licensing, " . . . the features of Denver's municipal water supply system upstream of Gross Reservoir are not part of the project's unit of development and therefore will not be placed under the license" (Order Issuing New License, 94 FERC ¶61,313, March 16, 2001."***
>
> Response:
> Please refer to the Application, Summary of Consultation, Attachment E-2, on pages 26-28 for Denver Water's response to a similar comment.

Internal Denver Water Comment Tracking Number: TEG-01-03
Comment and Letter Reference: Page 6, Paragraph 2

> ***"Total supply will equal demand in 2022. "Beginning in 2022 Denver Water predicts its average annual water demand will exceed available supplies . . . " (FEIS, ES-6). No numeric data are given to support this calculation. It appears that the year 2022 is based on a graph (Figure ES-3) showing a linear projection of demand 2010- 2050 in which the upward slanting demand line crosses the unvarying horizontal supply line of 345,000 AF in the year 2022. "Total system supply" is held constant at 345,000 AF, 2010-2050. The validity of this approach to determining supply and demand convergence depends on the accuracy of the demand line and the supply line. Both are invalid for current conditions as discussed below."***
>
> Response:
> Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-04
Comment and Letter Reference: Page 6, Paragraph 5

> ***"While the supply/demand convergence is moved forward six years, the 18,000 AF/yr shortfall is extended only 7 two years, 2030 to 2032, although as noted, the supply and demand numbers do not***

change. DEIS Table 1-1 and FEIS Table 1-1 have identical numbers for total system supply and total system demand for calculating the shortfall of 18,000 AF. From this perspective, the date of the 18,000 AF/yr shortfall appears to be arbitrary and merely a function of changing the date in the FEIS."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-05
Comment and Letter Reference: Page 7, Paragraph 4, Number 2, Sentence 3

"Recently the Denver Water Board of Commissioners increased the reserve to 200,000 AF (50,000 AF firm yield)."4 Like the previous reserve of 30,000 AF, this enormous reserve is not included in supply calculation. Increasing the "reserve" makes past droughts look more severe. Nonetheless, on a model-derived graph of reservoir content, 1634-2013, reservoir content would have fallen to 200,000 AF on only two occasions.5 Such episodes are rare, and 200,000 AF usable storage for "drought and emergencies" was not tapped—an enormous reserve."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-06
Comment and Letter Reference: Page 8, Number 3

"In calculating supply, Denver Water uses "additional conservation" savings of 16,000 AF remaining constant, 2010, 2032 and 2050 (FEIS, Table 1-1.) No rationale is given for this unchanging estimation. Conservation savings are cumulative and every year Denver Water conservation programs are enhanced."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-07
Comment and Letter Reference: Page 8, Number 4

"Supply is not static. As conservation increases, supply increases. To calculate total system supply, the line item "system refinements/cooperative actions" is added to "system supply." This addition to supply is held constant at 12,500 AF, 2010-2050. This is false. Every year Denver Water adds supply by repairing leaks and upgrading infrastructure. Every increase in supply extends the supply and demand convergence."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-08
Comment and Letter Reference: Page 8, Letter B, Number 1

"Faulty demand model. Denver Water uses a demand forecasting model with ten variables. The demographic and economic variables have a margin of error that the model does not incorporate, and confidence bands are not shown on demand tables."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-09
Comment and Letter Reference: Page 9, Paragraph 1, Sentence 5

"The model-driven shortfall of 34,000 AF is false. Denver Water's actual supply was not used in the projection, and water that is conserved, 16,000 AF/yr, is not demanded. Therefore, in this model driven scenario, the true projected shortfall should be 18,000 AF/yr. This illustrates again the inaccuracy of the demand model; the model cannot account for actual conservation."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-10
Comment and Letter Reference: Page 9, Letter A, Sentence 1

"The projected shortfall of 18,000 AF/yr cannot be verified because it is a derived figure based on estimated supply and demand variables, plus 3,000 AF contracted by the City of Arvada contingent upon completion of the project."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-01-11
Comment and Letter Reference: Page 9, Letter B, Sentence 1

"The figures used to derive the shortfall of 18,000 AF/yr in the FEIS were not critically analyzed by either Denver Water or the Corps, as evidenced by numerous problems—the least of which is the fact that water consumption is decreasing, not increasing as portrayed."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

TEG Section II Comment Letter:
Internal Denver Water Comment Tracking Number: TEG-02-01
Comment and Letter Reference: Page 11, Paragraph 2

"- The 80/20 supply ratio. These concerns are based primarily on an imbalance between the south collection system and the north collection system as noted above. We conclude that the "imbalance" is not as threatening as stated in the Moffat Project FEIS, and will not be solved by expanding Gross Reservoir.

- The crux of the problem appears to be that the Moffat system provides only 20 percent of total available supply while the south collection system provides 80 percent. The assumption is that this imbalance threatens the operation of the entire system because "loss of operation of any portion of the South system would require more water from the Moffat Collection System . . " On the other hand, the following is true: The Northern Collection System delivers water from the Williams Fork and Fraser rivers and provides approximately 31% of Denver Water's supply

- In practice, the north system provides considerably more than 20 percent of supply. Supply from the Moffat Collection System varies year to year because raw water is distributed across the three components of the total collection system—South Platte, Robert's Tunnel and Moffat. In 2013 the

north system provided 36 percent of total supply; during the drought in 2003 it provided 21 percent. In 2014 the Moffat system provided 24 percent of total supply."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-02-02
Comment and Letter Reference: Page 12, Paragraph 1

"- Flexibility and reliability. It is also the case that water delivery is not impeded when an entire south system treatment plant is shut down, and in winter a south plant and the Moffat treatment plant can be shut down with no interruption of service.

- In 2013 the Foothills plant was shut down for several months and in 2014 the Marston plant was shut down over the year while the reservoir outlet to the plant was being upgraded. The Moffat plant is shut down October-April every year. It is not the case that "loss of operation of any portion of the South system would require more water from the Moffat Collection System." The "imbalance" between the systems has no impact on operations even when a south treatment plant is shut down. Flexibility and reliability are built into the system.

- Worst-case scenario. In the event that both south plants were shut down simultaneously, in summer, with total delivery dependent on the Moffat treatment plant alone, it is unlikely that the additional supply from a totally filled Gross Reservoir would be able to meet demand for treated water across the system, and raw water deliveries from Gross/Ralston Reservoirs. No data are provided to show that it could. Furthermore, the FEIS provides no quantitative analysis of the likelihood of this happening and no quantitative analysis of the effects on actual water supply and delivery. If this "what if" scenario happened, Denver Water would treat the situation as it does drought conditions by limiting landscape watering and taking other measures to reduce demand. As an immediate back¬up, the treated clear water storage system holding 1,055.7 AF (344 million gallons) could add supply for emergencies.

- The actual imbalance in usable supply. Analysis of supply data reveals that an additional 72,000 AF in Gross Reservoir would not bring total supply in the north system above 20 percent. Reservoir supply and "usable" supply are shown below.23 Usable supply in the north system, with the additional 72,000 AF in Gross Reservoir, is below 20 percent of total. (SEE TABLE ON PAGE 12)

- These data indicate that the Moffat Project will not overcome the "imbalance" between the supply capacity of the south and the north systems. The explanation is simple: currently the imbalance between total usable supply of these systems is 92.8/7.1 percent. Current total usable supply is 518,271 AF; the north system usable supply is 37,087 AF (Gross Reservoir and Ralston Reservoir combined). The conclusion must be that this long-standing imbalance has not contributed to system vulnerability during normal operations and during plant shut-downs. This is because the entire supply system, north and south combined, is immense, and has built-in flexibility and is reliable. During the drought of 2002-2004 the strategic water reserve was maintained and raw water was delivered to Ralston Reservoir from the south system for north system raw water customers when Gross Reservoir was down to minimum pool level.

- The further conclusion must be that even with the ratio of south to north system supply of 80/20 with the Moffat Project at full capacity, according to Denver Water, the system-wide vulnerability threat would not be reduced. Therefore, the rationale for the expansion of Gross Reservoir, which would yield a 80/20 imbalance, is moot."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-02-03
Comment and Letter Reference: Page 13, Paragraph 3

"- The Moffat Treatment Plant. The capacity of the Moffat plant is another factor concerning the practicability of the Moffat Project. The use of additional supply in Gross Reservoir to solve the imbalance/vulnerability problem during a complete south system failure is constrained by the capacity of the treatment plant. Daily demand for treated water varies primarily with weather and irrigation needs. In summer with high demand, if both south treatment plants shut down or some other catastrophe occurred, the Moffat treatment plant would not be capable of handling demand.

- The year 2009 represents "the best case scenario" regarding lowest use of treated water due to a wet summer with 15 inches of rain, and water use was similar to the 2002-2004 drought. In 2009, maximum daily treated water consumption was 341,800,000 gallons; average over the year was 170,600,000 gallons per day.24 The Moffat treatment plant can process 185,000,000 gallons a day. In summer, the Moffat plant would be unable to keep up with demand, with a "deficit" of over 150,000,000 gallons a day. The capacity of Gross Reservoir has no bearing on this problem.

- It is noteworthy that treated water use in 2009 was essentially the same as in 200425 at the end of the 2002-2004 drought when landscape watering was restricted to twice a week (daily maximum was 340.9 million gallons and average daily was 165.6 million gallons). This indicates that even during a severe drought, with reduced water use, the Moffat plant would be unable to keep up with demand in summer particularly. Therefore, the Moffat Project will not solve the "worst case" vulnerability and flexibility needs during drought or during normal periods of high demand because an expanded reservoir does not change the capacity of the Moffat treatment plant."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-02-04
Comment and Letter Reference: Page 13, Last 2 Paragraphs

"- Conclusion. The supply "imbalance" between the south and north collection systems is not as threatening as described in the Moffat Project FEIS and the FERC application. Today the usable supply south/north system imbalance is 93/7 percent. It is curious that Denver Water did not use the more accurate usable supply to determine the imbalance. Reservoir capacity does not tell the entire story. The usable supply imbalance is remarkable, but obviously it has little impact on service. Perhaps this is why Denver Water did not reveal it.

- Treated water delivery is distributed across the entire system; the Moffat plant provides at least 31% of supply. The distribution system is designed for flexibility and reliability; a south system treatment plant shut-down does not put greater demand on the Moffat treatment plant than currently exists. In the event of the catastrophic scenario described in the Moffat Project FEIS, in which the entire south system is disabled, additional storage in Gross Reservoir would not solve the problem. Therefore, the "balance" purpose of the Moffat Project cannot be substantiated as a legitimate rational for the project."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

TEG Section III Comment Letter:
Internal Denver Water Comment Tracking Number: TEG-03-01
Comment and Letter Reference: Page 14, Paragraph 5, Sentence 7

"The relative cost screen was based on the least cost alternative, which was given a value of 1; the preferred action had the lowest cost. The 34 alternatives were given a value relative to the cost of the Moffat Project. For example, an alternative twice the cost of the Moffat Project was scored a 2. With a cutoff of 5, 19 alternatives were immediately eliminated. Further analysis will show that by cost alone the LEDPA might have been eliminated."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

Internal Denver Water Comment Tracking Number: TEG-03-02 and TEG-03-03
Comments and Letter Reference: Page 15, Letter A and Letter 5

"Cost estimates for the Moffat Project are underestimated. In the draft EIS and final EIS "total capital construction cost" for the Moffat Project is $139.9 million. In the Moffat Collection System Project Draft FERC Hydropower License Amendment Application (October, 2009, Table D-1, p. D-4), "total estimated construction cost" is $364,144,000. While the "construction costs" might not be identical in configuration, the discrepancy between the Corps estimates and the FERC estimates is significant."

"The higher figure in the draft FERC application is corroborated by the fact that the City of Arvada has budgeted $93,000,000 for the project. And as noted above, the line item "construction costs" is $54,344,667.26 $54,344,667 is 16.67 percent of $324,252,190. (Arvada agreed to pay 16.67 percent of project costs.) This figure approximates the construction cost in the FERC application. This estimation is not new."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above, to the response to FORM-10 and to the Application, Exhibit D, which sets forth cost criteria and information per FERC regulations at 18 C.F.R. §4.41.

Internal Denver Water Comment Tracking Number: TEG-03-04
Comment and Letter Reference: Page 17, Paragraph 4

"In the final EIS for the Corps, "no action" for the Moffat Project refers to continuing with conservation measures, non-potable recycling and system refinements. Denver Water concludes however, that the No Action alternative would not prevent the convergence of supply and demand in 2022. Further, the No Action alternative would require . . . "imposing more frequent and mandatory restrictions during drought periods." And, ". . . Gross Reservoir would be frequently drawn down to the minimum operating pool."29 The assertion seems to be that "no action" will actually cause more droughts. In fact, droughts and emergencies are rare—the PACSM model predicts a possible draw-down of Gross Reservoir 4 times in 45 years; in most years the system would operate as usual."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above.

TEG Section IV Comment Letter:
Internal Denver Water Comment Tracking Number: TEG-04-01
Comment and Letter Reference: Page 20, Paragraph 3

> ***"Haul studies. Original analysis of traffic impacts was based upon haul studies performed by Harvey Economics (Denver Water, 2012b), 'HDR 2012,' for Denver Water, using 15 cu. yd. trucks for the 4.1 year, 260 days/yr construction period. Estimated average and peak one-way daily truck trips are shown in Table 2-19 as 22 and 37 respectively and daily worker commuter trips are shown similarly as 60 and 101. Fly ash and cement would be hauled to Gross Reservoir and trucks associated with these materials and must be accounted for. It is possible to arrive at a more accurate count of daily truck trips—subtracting 16 trips—by using information in the 2012 study:"***
>
> Response:
> Please refer to the responses to BC-08 through BC-11 above.

Internal Denver Water Comment Tracking Number: TEG-04-02
Comment and Letter Reference: Page 20, Paragraph 6

> ***"Denver Water is still vague about hauls of logs and slash, but HDR 2012, Table B-8, estimates 6 loads/day in the first construction year. For a 10-hour day, peak load is 50 + 6 = 56/10 = 5.6 trucks/hour in the initial year and average loads are 3.6 trucks/hour. This does not include the steel pipe that will be part of the dam structure nor miscellaneous supplies."***
>
> Response:
> Please refer to the responses to FORM-12 and BC-11 above.

Internal Denver Water Comment Tracking Number: TEG-04-03
Comment and Letter Reference: Page 21, Paragraph 3

> ***"Concern for public safety is a FERC mandate. This is clearly a case for a license amendment condition requiring Denver Water to mitigate traffic hazards either by constructing climbing lanes on Hwy 72 or by doing whatever it takes to use the railroad to delivery materials where the tracks cross Gross Dam Road—an option that has been rejected so far. To date, Denver Water will not construct a bike lane, or pay for climbing lanes; the only traffic mitigation being considered is widening pull-outs. It is unlikely however, that truckers would use pull-outs going up the canyon because regaining speed takes time and distance."***
>
> Response:
> Please refer to the responses to FORM-15 and BC-08 through BC-10 above. Please also refer to the Application, Summary of Consultation, Attachment E-2, on page 33-37 for Denver Water's responses to similar comments.

Internal Denver Water Comment Tracking Number: TEG-04-04
Comment and Letter Reference: Page 21, Paragraph 4

> ***"There are also deeply flawed assumptions that make the planned construction schedule impossible to meet and exacerbate the negative impacts outlined above. For example, HDR 2012 assumes an average 40 mph haul truck speed on Hwy 72. There is an 8.5-mile segment from Hwy 93 to Gross Dam Rd., of which 6.8 miles are curving mountainous grades with posted speed limits of 25 and 35 mph in some areas. As described in Appendix A, this mountainous segment has numerous blind driveways, blind curves, school bus stops, commercial establishments, a total of 92 warning signs and***

an elevation gain of 1510 feet. The altitude gain from the beginning of the canyon to Wondervu pass is 2,151 feet in 9.9 miles. With convoys of trucks followed by long lines of cars in both directions, there will be many occasions when trucks will have to stop or slow to a crawl. It will then take time and distance to regain speed (see data in AASHTO, 2004: p. 235 for information on heavy truck acceleration on upgrades and downgrades)."

<u>Response</u>:
Please refer to the previous response above. In addition, Denver Water has met with industry experts, contractors, and other utilities who have built similar projects and received feedback that the estimated project schedule is achievable and realistic.

<u>TEG Section V Comment Letter</u>:
Internal Denver Water Comment Tracking Number: TEG-05-01
Comment and Letter Reference: Page 23, Paragraph 4

"Additional divertible water from the West Slope basins is not adequate. The extensive firm yield analyses by Buchanan provides technical evidence that additional divertible flows at existing diversion structures in the upper Fraser and Williams Fork basins are not sufficient to yield an additional water supply of 18,000 acre-feet per year to Denver Water's northern system. [See Appendix D, 'Evaluation of Feasibility of Attaining 18,000 AFY of Firm Yield from Excess Flows Remaining in the Fraser and Williams Fort Basins Combined with 72,000 AF Additional Storage in the Expanded Gross Reservoir', Buchanan, 2014 revised 2015.]"

<u>Response</u>:
Please refer to Denver Water's response to NEPA and CWA comments above.

<u>TEG Section VI Comment Letter</u>:
Internal Denver Water Comment Tracking Number: TEG-06-01
Comment and Letter Reference: Page 29, Paragraph 1

"Denver Water is not a climate change denier. However, the discussion of climate change in the FEIS application focuses primarily what is not known, lack of science and lack of research ergo an inability to make predictions of stream flow based on air temperature changes. The discussion refers to "recent" publications of 2007 and 2008. However, Denver Water states, 'Scientific studies have predicted that, because steam flows may peak earlier, evapotranspiration may be higher, and droughts may be longer and severe, it is also likely that water demands would increase in correlation with rising air temperatures.' (Vol. II, E-32). On the contrary, during such conditions water demand may more likely decrease, as it has in the past during drought conditions."

<u>Response</u>:
Please refer to the response to FORM-16 above.

Internal Denver Water Comment Tracking Number: TEG-06-02
Comment and Letter Reference: Page 29, Paragraph 2

"The discussion of earthquake potential in the FERC application is the same as in the final EIS for the Corps, ending with "Potential issues related to seismicity will be addressed through geotechnical and seismic studies in the design and construction phases. (Vol. II, E-106.) If these issues can be studied then, they can be studied now—and should be. Agencies should then evaluate these studies before approval, not after."

Response:
Please refer to the response to FORM-18 above.

Internal Denver Water Comment Tracking Number: TEG-06-03
Comment and Letter Reference: Page 30, Paragraph 1

"For residents of Boulder County, Coal Creek Canyon and beyond, the only benefit of a reservoir on South Boulder Creek is recreation—boating, kayaking, fishing, hiking and enjoying a picnic by the water. We gain neither drinking water nor electricity from Gross Reservoir. For many who oppose the Moffat Project, the disruption of recreation activities is a key factor, from loss of the beautiful Forsythe Falls area that will be inundated, to years of blasting, crushing, and other disruptive construction activity, beginning with months of offensive tree cutting and disposal. And all this during the months when the reservoir draws visitors from near and far—spring, summer and fall. No one would want to spend the day at Gross Reservoir during construction of the raised dam. Denver Water plans to keep some recreational areas open during construction—unlikely to be used. We must also consider the possibility that the expanded reservoir may not fill for several years, or ever, creating environmental and recreational hazards, as discussed in Section V. Mitigation cannot change this."

Response:
Please refer to the responses to FORM-17 and TB-07 and 08 above.

Internal Denver Water Comment Tracking Number: TEG-05-04
Comment and Letter Reference: Page 30, Paragraph 4

"There is currently no reopener clause included in the Denver Water proposal – it should be required. A reopener clause is a precautionary measure in this case. There is a significant likelihood that the Moffat Project will not meet its primary purpose to 'develop 18,000 acre-feet per year of new, annual firm yield to the Moffat Treatment Plane and raw water customers upstream of the Moffat Treatment Plant pursuant to Denver Water's commitments to is customers.' An extensive firm yield analysis (Section V of this document and Appendix D) demonstrates that the expanded portion of Gross Reservoir will not fill as expected; in many years it will remain less than half full or empty."

Response:
Please refer to Denver Water's response to NEPA and CWA comments above. The Moffat Project is regulated under the Clean Water Act (sections 401 and 404) and under the Federal Power Act. The Moffat Project will be constructed and operated per the various terms and conditions of such approvals.

ATTACHMENTS

Attachment 1 – Gross Dam Noise Impact Report (May 2017)

Gross Dam Noise Impact Report

May 4, 2017

Prepared for:

Denver Water
1600 West 12th Street
Denver, CO 80204

Prepared by:

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1. Executive Summary

Denver Water is proposing to raise the Gross Dam by approximately 131 feet to increase the storage volume by 77,000 acre-feet. To complete construction of the Dam, approximately 930,000 cubic yards of Roller Compacted Concrete is required. The current plan is to produce the concrete by mining rock from one of two possible quarries, the FEIS Quarry and the Osprey Quarry. This Noise Impact Report has been conducted in addition to the Behrens and Associates report titled Moffat Collection System Project Noise and Vibration Impact Analysis Report dated February 28, 2014. The results of this Noise Impact Report are consistent with what was presented in the EIS analysis. The EIS also included the same applicable noise limits as shown in Table 1-2 and Table 1-3 of this study.

An ambient sound level survey was performed at three locations nearby the Gross Dam over a period of seven days from February 22 to March 1, 2017. The average ambient sound levels calculated from the survey are shown in Table 1-1.

Table 1-1 Average Ambient Sound Levels (dBA)

Time Period	Location 1	Location 2	Location 3
Daytime (6 AM to 6 PM)	47.4	41.6	54.8
Evening (6 PM to Midnight)	40.4	37.3	51.2
Nighttime (Midnight to 6 AM)	30.3	25.8	45.5

The modeled noise levels have been assessed at the nearest residences adjacent to the ambient measurement locations. The noise limits used in the assessment include the Boulder County, Jefferson County and State of Colorado construction noise limits outlined in Section 4. The noise limits for the daytime, evening and nighttime periods are shown in Table 1-2 for continuous noise. The noise limits for the daytime, evening and nighttime periods are shown in Table 1-3 for instantaneous noise applicable to blasting activities.

Table 1-2 Applicable Noise Limits for Continuous Noise (dBA)

Time Period	Boulder County / Jefferson County / State of Colorado Construction Noise Limits
Daytime (6 AM to 6 PM)	80 dBA
Evening (6 PM to Midnight)	75 dBA
Nighttime (Midnight to 6 AM)	75 dBA

Table 1-3 Applicable Noise Limits for Instantaneous Noise (dBA)

Time Period	Boulder County / Jefferson County / State of Colorado Construction Noise Limits
Daytime (6 AM to 6 PM)	75 dBA
Evening (6 PM to Midnight)	70 dBA
Nighttime (Midnight to 6 AM)	70 dBA

*Note: Blasting activities for the Gross Dam project will typically occur once per day during daytime hours.

To ensure that the noise impact is determined for the proposed construction activities and project alternatives, seven scenarios have been identified and included in the analysis. Each scenario has been chosen based on the loudest proposed activities occurring simultaneously during the day, evening and nighttime periods. The assessment has been conducted at three receptors, which have been placed at residences adjacent to the ambient measurement locations to the north and south of the project area as shown in Figure 6-1.

The noise modeling results for each scenario are presented in Table 1-4 to Table 1-8. For Scenarios 1, 2, 3, 6 and 7 noise levels have been calculated for Years 1-2 and Year 3 to account for the variation in construction equipment and work elevation during the project. To represent Years 1-2, construction has been modeled at an elevation of 7,110 feet. For Year 3, construction has been modeled above the existing dam crest at an elevation of 7,280 feet.

Table 1-4 Daytime Noise Modeling Results for Years 1-2 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
1. FEIS Quarry Daytime with Haul Trucks	33.7	42.4	33.4
2. Osprey Quarry Daytime with Haul Trucks	30.9	47.0	34.1
3. Osprey Quarry Daytime with Conveyor	41.2	48.9	36.8
State and County Noise Limit	**80.0**	**80.0**	**80.0**

Table 1-5 Daytime Noise Modeling Results for Year 3 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
1. FEIS Quarry Daytime with Haul Trucks	45.0	43.0	33.6
2. Osprey Quarry Daytime with Haul Trucks	44.8	47.2	34.3
3. Osprey Quarry Daytime with Conveyor	46.3	49.0	36.9
State and County Noise Limit	**80.0**	**80.0**	**80.0**

Table 1-6 Instantaneous Blasting Noise Modeling Results (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
4. FEIS Quarry Daytime Blasting	51.2	55.9	46.9
5. Osprey Quarry Daytime Blasting	34.1	64.4	49.4
State and County Noise Limit	**75.0**	**75.0**	**75.0**

Table 1-7 Evening and Nighttime Noise Modeling Results for Years 1-2 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
6. Construction Evening	30.6	30.1	32.3
7. Shift Work Construction Nighttime	22.5	20.5	24.2
State and County Noise Limit	**75.0**	**75.0**	**75.0**

Table 1-8 Evening and Nighttime Noise Modeling Results for Year 3 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
6. Construction Evening	44.8	35.5	32.6
7. Shift Work Construction Nighttime	38.1	28.3	25.5
State and County Noise Limit	**75.0**	**75.0**	**75.0**

To reduce noise levels for Scenario 3- Osprey Quarry Daytime with Conveyor it is recommended that aluminum idler rollers are used in place of steel idler rollers. The results of the modeling with the steel and aluminum idler rollers are shown in Table 1-9 and Table 1-10.

Table 1-9 Scenario 3 with Steel and Aluminum Rollers for Years 1-2 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
3. Osprey Quarry Daytime with Conveyor (steel idler rollers)	41.2	48.9	36.8
3. Osprey Quarry Daytime with Conveyor (aluminum idler rollers)	35.4	47.3	34.7
State and County Noise Limit	**80.0**	**80.0**	**80.0**

Table 1-10 Scenario 3 with Steel and Aluminum Rollers for Year 3 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
3. Osprey Quarry Daytime with Conveyor (steel idler rollers)	46.3	49.0	36.9
3. Osprey Quarry Daytime with Conveyor (aluminum idler rollers)	45.2	47.5	34.8
State and County Noise Limit	**80.0**	**80.0**	**80.0**

The predicted noise levels at the receptors due to project related activates for Scenarios 1 to 3 range between 30.9 dBA and 49.0 dBA. The predicted noise levels at the receptors due to project related activates for Scenarios 6 and 7 range between 20.5 dBA and 44.8 dBA. Generally speaking, noise levels within these ranges are representative of a quiet urban environment as shown in Figure 3-1. It is expected that inside residences, noise levels will be significantly lower and are not likely to be intrusive.

The ambient sound survey conducted from February 22 to March 1, 2017 is during winter when there is less activity occurring in the area. Additionally, temperatures are significantly lower during this period which are generally less favorable for noise propagation. As a result, ambient noise levels are expected to be lower during winter. The Gross Dam project is scheduled to occur during summer months where ambient noise levels would be higher.

2. Introduction

2.1 Project Description

Denver Water is proposing to raise the Gross Dam by approximately 131 feet to increase the storage volume by 77,000 acre-feet. To complete construction of the Dam, approximately 930,000 cubic yards of Roller Compacted Concrete is required. The current plan is to produce the concrete by mining rock from one of two possible quarries, the FEIS Quarry and the Osprey Quarry. Rock will be blasted and drilled out of the quarry, processed at an onsite aggregate processing plant, then transported to a concrete batch plant nearby the construction site for use on the dam construction. The aggregate from the processing plant will be transported to the concrete batch plant by either haul trucks or a conveyor.

The project construction site is located approximately 2 miles north of Highway 72, off Gross Dam Road in Boulder County, Colorado. A map of the project area is shown in Figure 2-1.

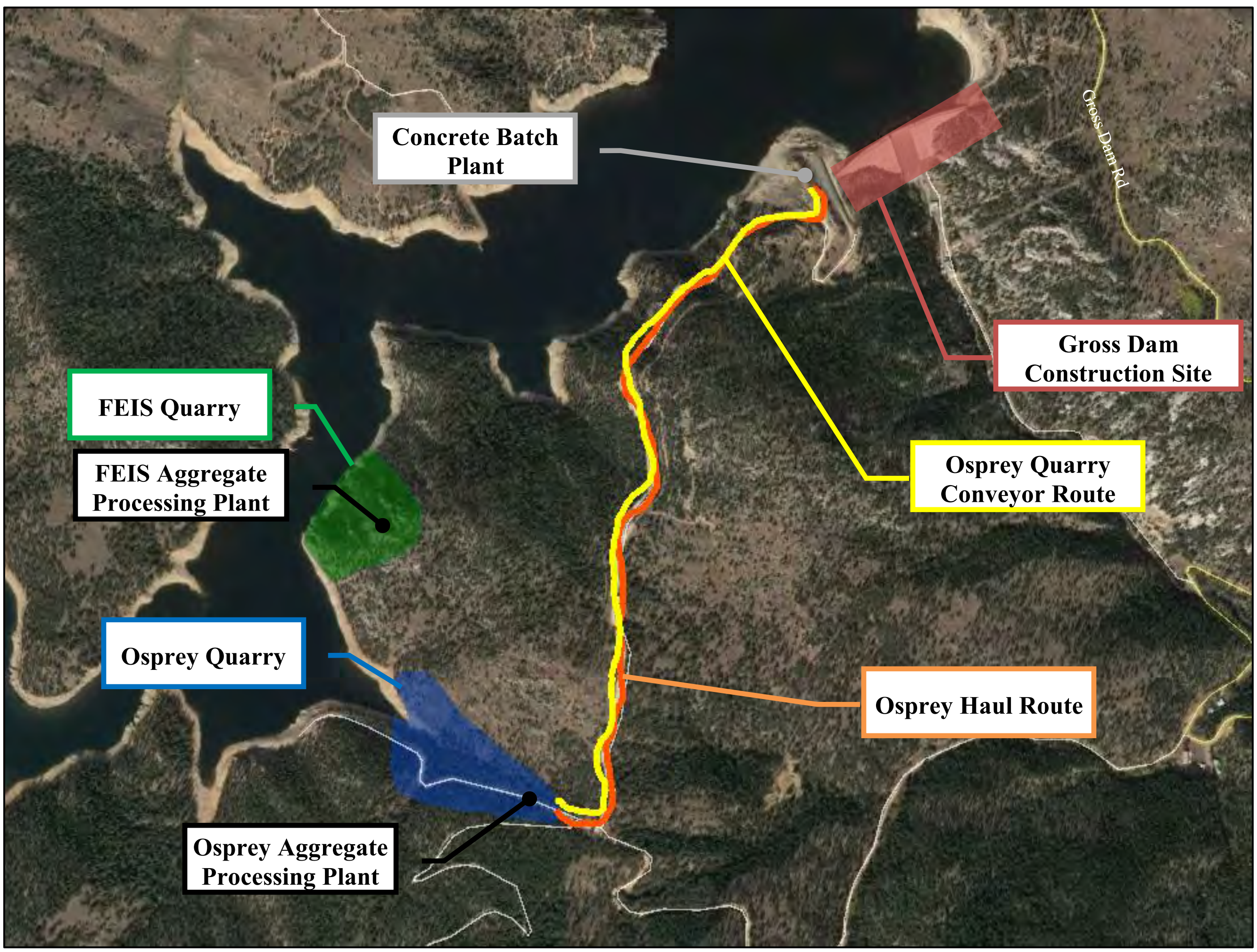

Figure 2-1 Project Location

2.2 Purpose of Study and Objectives

The purpose of this study is to analyze the noise levels from the proposed construction operations and determine the noise impact at the nearest residences of the proposed quarry locations and aggregate transport method. Ambient noise measurements were performed to document existing noise levels at the surrounding residential areas. Noise was assessed relative to the Boulder County, Jefferson County and State of Colorado construction noise limits. Noise levels were predicted for each of the following activities:

- Dam construction
- Operation of the aggregate processing plant
- Operation of the concrete batch plant
- Haul truck traffic
- Operation of the Conveyor
- Drilling activities associated with charge setting
- Blasting activities

To allow for comparison of the noise impact due to the various project alternatives, predicted noise levels at the nearest residential properties to the ambient measurement locations were assessed for each proposed quarry location and aggregate transport method. In addition to this, the noise impact was determined based on the work schedule for a typical work day in three shifts: the day shift (6 AM to 6 PM), evening shift (6 PM to 12 AM) and night shift (12 AM to 6 AM).

2.3 Project Location and Study Area

The proposed haul routes and conveyor routes are shown in Figure 2-1. The proposed FEIS Quarry option includes a one-way haul truck loop, which will rejoin the road to the concrete batch plant shown in orange. The haul truck loop is expected to allow trucks to transport aggregate in the counterclockwise direction. There is no proposed conveyor for this option.

The Osprey Quarry option includes a two-way haul truck road shown in orange. This option also includes a one mile long conveyor which could be used instead of the haul truck road to transport aggregate to the concrete batch plant.

The FEIS Quarry and the Osprey Quarry options both utilize the concrete batch plant and construction equipment operation at the construction site shown in Figure 2-1. The aggregate processing plants for each quarry option are located on their respective quarry site.

2.4 Gross Dam Noise Impact Studies

Denver Water funded an earlier Behrens sound study performed in 2013 and finalized in early-2014 titled, "Moffat Collection System Project Noise and Vibration Impact Analysis Report." The report examined the truck hauling and blasting impacts of the project, and found that the planned FEIS quarry activities as well as the truck hauling will not exceed significant thresholds at the nearby residences. Three of the six locations used in the 2014 report have a potential for increased noise levels during peak haul route activities, primarily due to the low volume of truck and vehicular traffic in those areas.

This 2017 noise impact report examined the proposed construction equipment and the quarry operation's noise impacts to three locations around Gross Reservoir; analyzing numerous different scenarios based on the type of work that would be performed during specific periods of construction during a 24-hour work day. This report found that the applicable noise ordinances will not be exceeded for both quarry and dam construction at all three locations.

Overall, both studies were conducted conservatively to analyze impacts of a worst-case scenario – The 2014 report modeled the maximum volume of trucks that is proposed for the project, while the underlying noise model for the 2017 report included the maximum number of noise-generating pieces of equipment that could be operating at one time in each potential quarry location and vicinity.

3. Noise Fundamentals

Sound is most commonly experienced by people as pressure waves passing through air. These rapid fluctuations in air pressure are processed by the human auditory system to produce the sensation of sound. The rate at which sound pressure changes occur is called the frequency. Frequency is usually measured as the number of oscillations per second or Hertz (Hz). Frequencies that can be heard by a healthy human ear range from approximately 20 Hz to 20,000 Hz. Toward the lower end of this range are low-pitched sounds, including those that might be described as a “rumble” or “boom”. At the higher end of the range are high-pitched sounds that might be described as a “screech” or “hiss”.

3.1 Environmental Noise

Environmental noise generally derives, in part, from a combination of distant noise sources. Such sources may include common experiences such as distant traffic, wind in trees, and distant industrial or farming activities. These distant sources create a low-level "background noise" in which no particular individual source is identifiable. Background noise is often relatively constant from moment to moment, but varies slowly from hour to hour as natural forces change or as human activity follows its daily cycle.

Superimposed on this low-level, slowly varying background noise is a succession of identifiable noisy events of relatively brief duration. These events may include the passing of single-vehicles, aircraft flyovers, screeching of brakes, and other short-term events. The presence of these short-term events causes the noise level to fluctuate. Typical indoor and outdoor A-weighted sound levels are shown in Figure 3-1. Detailed acoustical definitions have been provided in Appendix A - Glossary of Acoustical Terms.

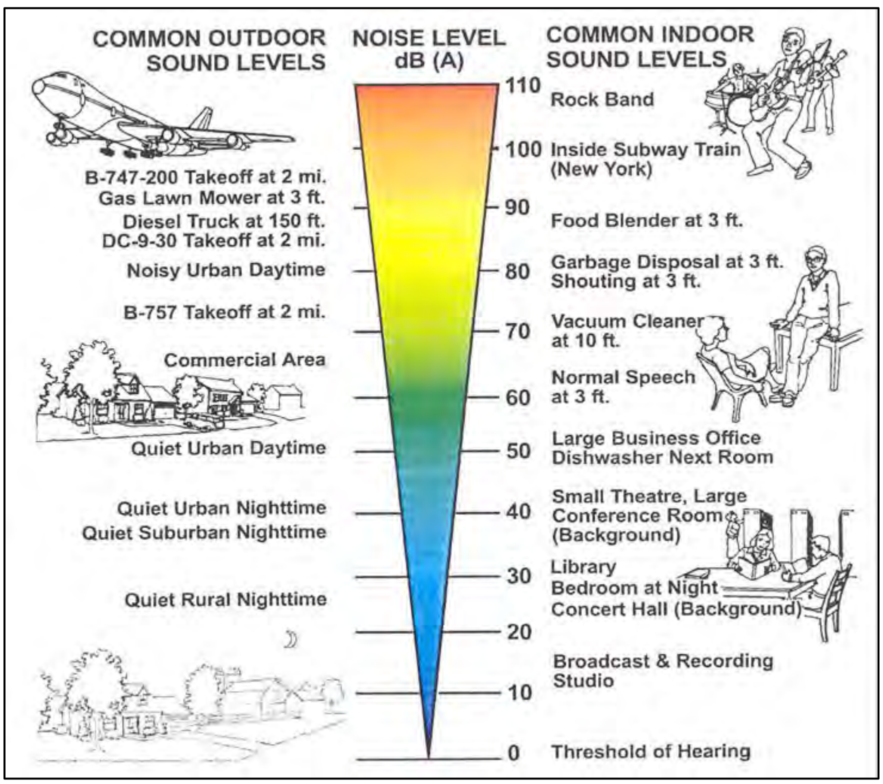

Figure 3-1 Typical Indoor and Outdoor A-Weighted Sound Levels

3.2 Construction Noise

Construction noise is noise that arises from an activity at a construction site such as demolition, site preparation work, building construction and repairs, concrete pouring and pile driving. Construction noise varies in nature from impulse noises such as hammering to constant noise sources such as welding or drilling. Similarly to other noise sources, the propagation of construction noise is dependent on distance, elevation, topography, shielding and weather conditions.

Modeled construction noise levels do not take into account the ambient noise levels occurring in the vicinity of the site. Even if the modeled construction noise levels are below the ambient sound level at a given location, it is still possible for the construction noise to be audible. Audibility is dependent on many factors including the listener's ability to hear and distinguish between different sounds, the character of the noise or whether audible tones are present. If predicted noise levels due to construction activities are analyzed as additive noise to the environment, sound levels should be logarithmically added, not arithmetically added. For example, adding 50 dB and 50 dB equates to 53 dB not 100 dB.

4. Noise Standards

The relevant noise standards for the Gross Dam Project are presented in the following Sections.

4.1 Boulder County Noise Ordinance

The Boulder County Noise Ordinance Section 1.01.050(c) contains noise limits applicable to non-vehicular noise sources located in a residential area as shown in Table 4-1.

Table 4-1 Boulder County Non-vehicular Noise Limits

Time of Day	Non-vehicular Noise Limit
7:00 a.m. – 7:00 p.m.	55 dBA
7:00 p.m. – 7:00 a.m. Of the following day	50 dBA

*Note: Per Section 1.01.040(c), the above noise level limits are applicable 10 feet from the property line.

The non-vehicular noise limits are not applicable to construction noise. Section 1.01.050(d) of the ordinance states specific noise limits applicable to construction activities shown in Table 4-2.

Table 4-2 Boulder County Construction Noise Limits

Time of Day	Construction Noise Limit
7:00 a.m. – 7:00 p.m.	80 dBA
7:00 p.m. – 7:00 a.m. Of the following day	75 dBA

In addition to this, Section 1.01.050(e) states that “Periodic, impulsive, or shrill noises are hereby declared unlawful when such noises are at or above a sound level of five dB(A) less than those listed in sections 1.01.050(A), (B), (C), and (D) above.” This section of the ordinance is applicable to blasting which is impulsive noise. The Boulder County noise limits for blasting are therefore 75 dBA from 7 AM to 7 PM and 70 dBA from 7 PM to 7 AM the following day.

It is important to note that Section 1.01.060(e) states that noise limits in Section 1.01.050 shall not apply to “public utilities regulated pursuant to Title 40, C.R.S.” and may not be applicable to the Gross Dam project.

4.2 Jefferson County Noise Abatement Policy

The Jefferson County Noise Abatement Policy Section D3 states the same noise limits as Boulder County for non-vehicular noise sources and construction noise sources shown in Table 4-1 and Table 4-2. The noise limits applicable to periodic, impulsive or shrill noises found in Section D4 are also identical to the Boulder County Noise Ordinance. However, there are no exceptions granted to public utilities therefore these noise limits are applicable to the Gross Dam project.

4.3 State of Colorado Noise Statute

The Colorado Noise Statute establishes maximum permissible noise levels based on property zoning. Section 25-12-103(1) states, “every activity to which this article is applicable shall be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. Sound levels of noise radiating from a property line at a distance of twenty-five feet or more therefrom in excess of the db(A) established for the following time periods and zones shall constitute prima facie evidence that such noise is a public nuisance." The noise limits and applicable time periods are identical to the Boulder and Jefferson County noise limits for residential areas as shown in Table 4-1.

The noise limits applicable to periodic, impulsive or shrill noises found in Section 25-12-103(3) are also identical to the Boulder County and Jefferson County noise ordinances.

Section 25-12-103(5) states, "construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for the period within which construction is to be completed." The noise limits for industrial zones are identical to the construction noise limits found in the Boulder and Jefferson County noise ordinances and presented in Table 4-2.

5. Ambient Sound Level Survey

5.1 Ambient Survey Location and Instrumentation

An ambient sound level survey was performed at three locations nearby the Gross Dam over a period of seven days from February 22 to March 1, 2017. Svantek 971 sound level meters were deployed at the measurement locations shown in Figure 5-1. The serial numbers of the sound level meters were 55474, 56241 and 44598 for Locations 1, 2 and 3 respectively. The sound level meters were calibrated with a Quest QC-10 calibrator and microphones were positioned approximately 5 feet above ground level. In addition to the sound level meters, a Davis Vantage Vue weather station was deployed at Location 2 for the duration of the measurement period. Figure 5-1 shows the location of the sound level meters in relation to the Gross Dam. Additional maps have been provided in Appendix B - Ambient Survey Locations to show the meter locations at a greater resolution.

Figure 5-1 Ambient Survey Measurement Locations

5.2 Ambient Sound Level Survey Results

The weather station was set to record temperature, humidity, wind speed, wind direction and precipitation at 15 minute intervals. Temperatures recorded ranged between 3.5 degrees and 44.0 degrees Fahrenheit with no periods of sustained precipitation. Wind conditions during the survey period were calm between February 22 and February 25. Wind conditions then became gusty for the remainder of the measurement period between February 25 and March 1. The weather data recorded is presented in graphical form in Figure 5-2 and Figure 5-3, and in tabular form in Appendix C - Tabulated Weather Data.

The measured sound level data is presented as one-hour average (1-hr Leq) sound levels graphically in Figure 5-4 and in tabular form in Appendix D - Tabulated Ambient Sound Level Data. The chart contains the measured A-weighted (dBA) sound levels. The A-weighted filter is applied to instrument-measured sound levels in an effort to account for the relative loudness perceived by the human ear. As the human ear is less sensitive to low frequencies, the A-weighted filter correspondingly discounts low frequency sound observed during measurements and is widely utilized for environmental noise measurements. Periods where maximum wind speeds were greater than 10 miles per hour have been identified on the graph.

To determine the ambient sound levels at the measured locations, the hourly sound pressure levels were logarithmically averaged for three time periods based on the work schedule during a typical work day. The three time periods include the daytime shift between 6 AM and 6 PM, the evening shift between 6 PM and midnight and the nighttime shift between midnight and 6 AM. The average sound level calculated for each time period was then logarithmically averaged across each measurement day to determine the average ambient sound level. Periods where maximum wind speeds were greater than 10 miles per hour have been excluded from the averages. Excluding hourly data for wind speeds greater than 10 miles per hour correlates with excluding approximately one-third of the data measured. Reducing the maximum wind speed to a lower threshold for example, 5 mph, would eliminate over half the data gathered and may result in underestimating the average ambient noise level.

The average ambient sound levels calculated are shown in Table 5-1. The ambient sound levels for each measurement day are shown in Appendix E - Ambient Sound Level Averages.

Table 5-1 Average Ambient Sound Levels (dBA)

Time Period	Location 1	Location 2	Location 3
Daytime (6 AM to 6 PM)	47.4	41.6	54.8
Evening (6 PM to Midnight)	40.4	37.3	51.2
Nighttime (Midnight to 6 AM)	30.3	25.8	45.5

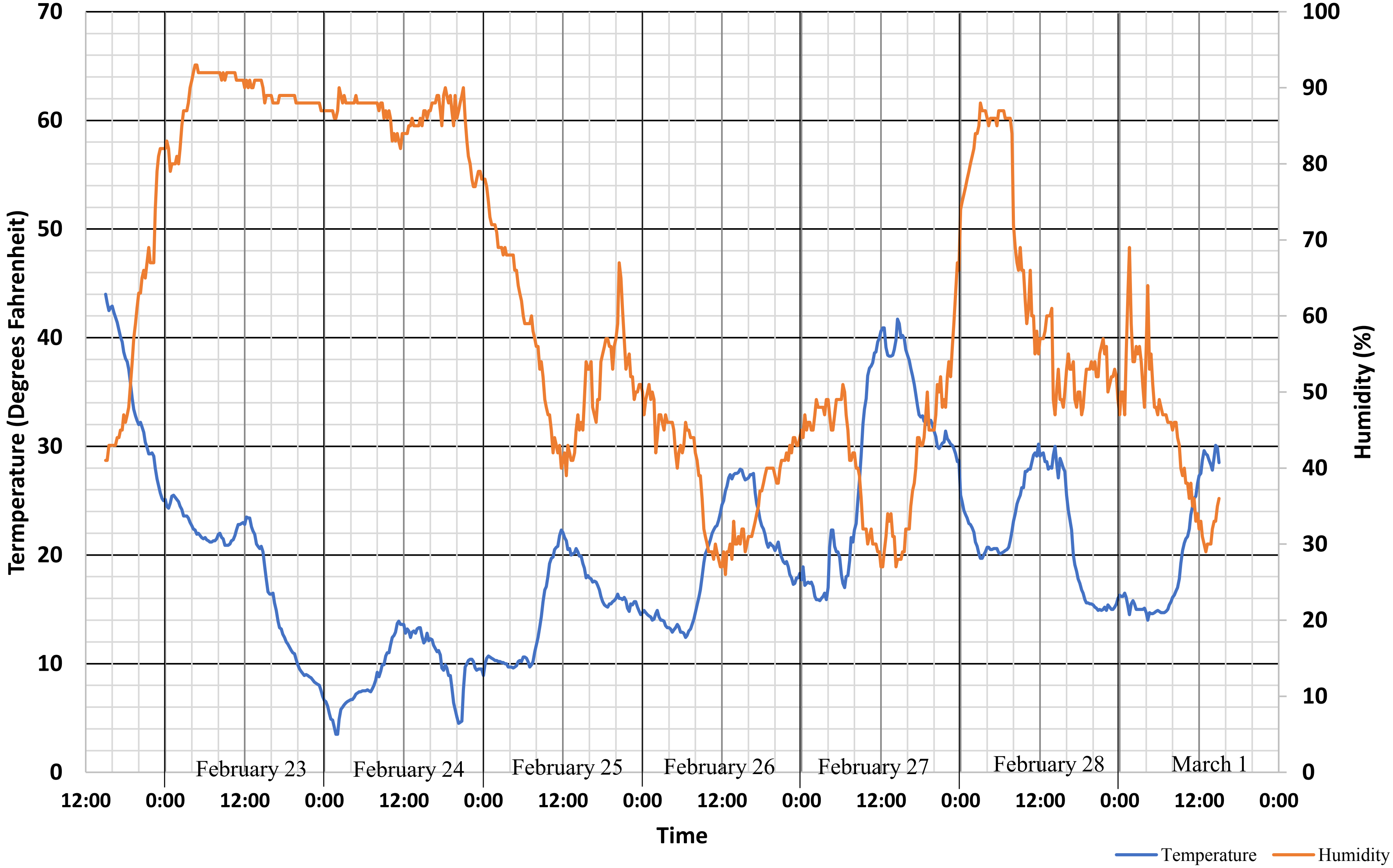

Figure 5-2 Measured Temperature and Humidity Data

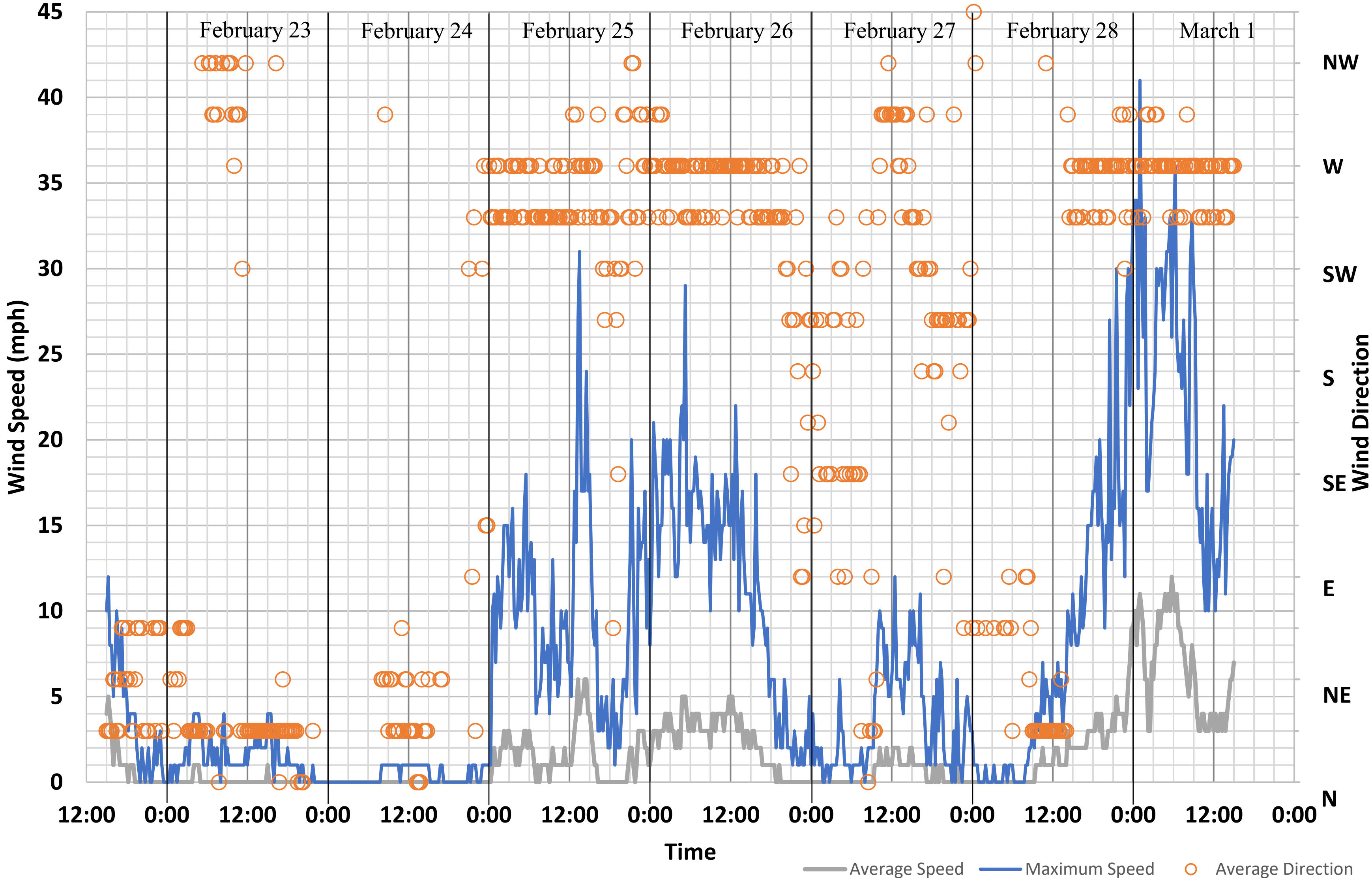

Figure 5-3 Measured Wind Speed and Direction Data

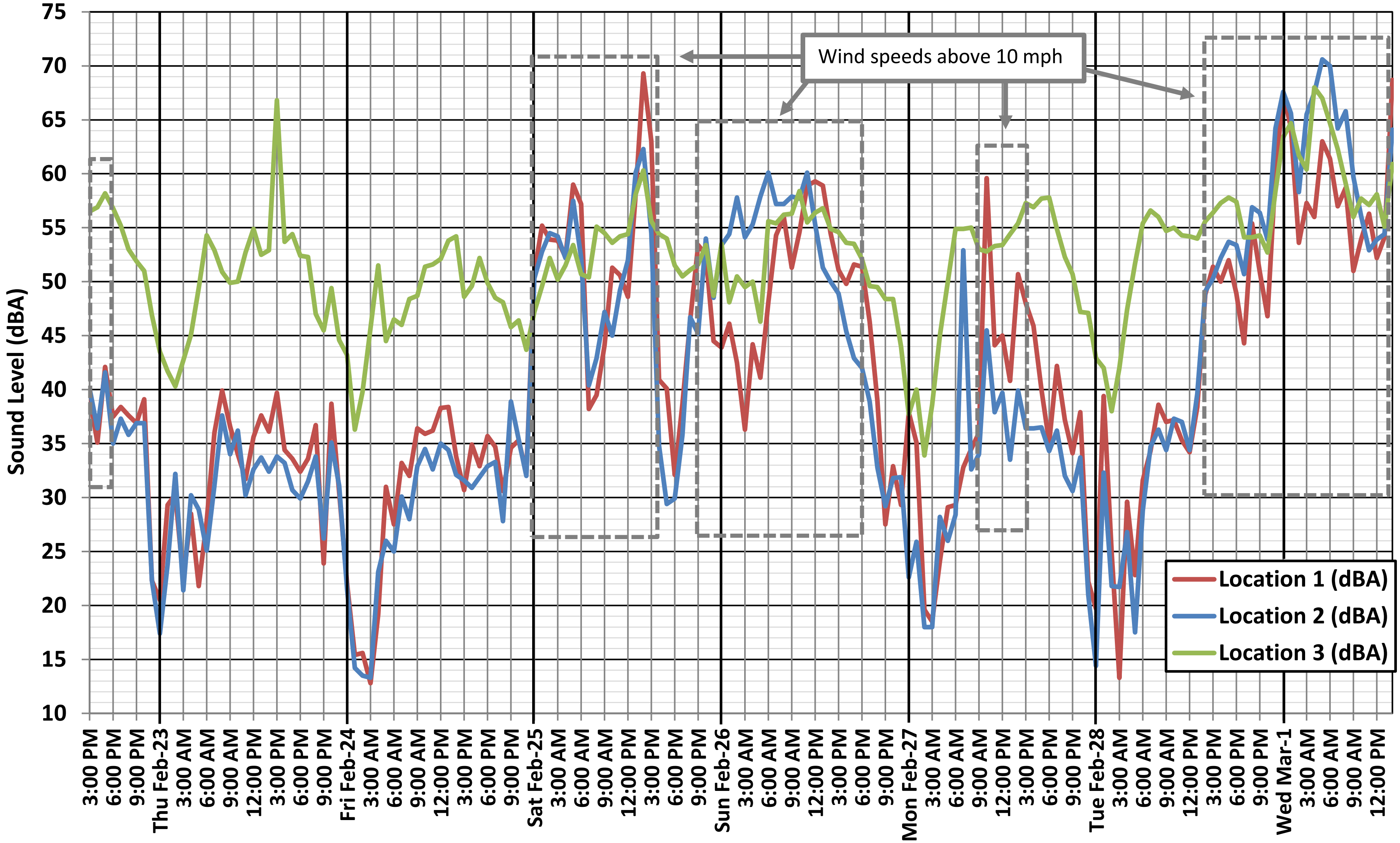

Figure 5-4 Measured Sound Level Data (dBA)

6. Gross Dam Construction Noise Modeling

The noise modeling was completed with use of three-dimensional computer noise modeling software. All models in this report were developed with SoundPLAN 7.4 software using the ISO 9613-2 standard. Noise levels are predicted based on the locations, noise levels and frequency spectra of the noise sources, and the geometry and reflective properties of the local terrain, buildings and barriers. To ensure a conservative assessment and compliance with ISO 9613-2 standards, light to moderate winds are assumed to be blowing from the source to receptor.

6.1 Assessment and Receptor Locations

Receptors have been placed at the nearest residences adjacent to the ambient measurement locations as shown in Figure 6-1. There were no residences identified to the west of the project area within one mile. Receptor 1 is located at 370 Lakeshore Drive, Boulder approximately 0.65 miles from the dam construction area. Receptor 2 is located off Miramonte Road approximately 0.4 miles from the Osprey aggregate processing area. Receptor 3 is located off Coal Creek Canyon Road approximately 1.18 miles from the Osprey aggregate processing area.

The modeled noise levels have been assessed at the nearest residences adjacent to the ambient measurement locations. The noise limits used in the assessment include the Boulder County, Jefferson County and State of Colorado construction noise limits outlined in Section 4. The noise limits for the daytime, evening and nighttime periods are shown in Table 6-1 for continuous noise. The noise limits for the daytime, evening and nighttime periods are shown in Table 6-2 for instantaneous noise applicable to blasting activities.

Table 6-1 Applicable Noise Limits for Continuous Noise (dBA)

Time Period	Boulder County / Jefferson County / State of Colorado Construction Noise Limits
Daytime (6 AM to 6 PM)	80 dBA
Evening (6 PM to Midnight)	75 dBA
Nighttime (Midnight to 6 AM)	75 dBA

Table 6-2 Applicable Noise Limits for Instantaneous Noise (dBA)

Time Period	Boulder County / Jefferson County / State of Colorado Construction Noise Limits
Daytime (6 AM to 6 PM)	75 dBA
Evening (6 PM to Midnight)	70 dBA
Nighttime (Midnight to 6 AM)	70 dBA

*Note: Blasting activities for the Gross Dam project will typically occur once per day during daytime hours.

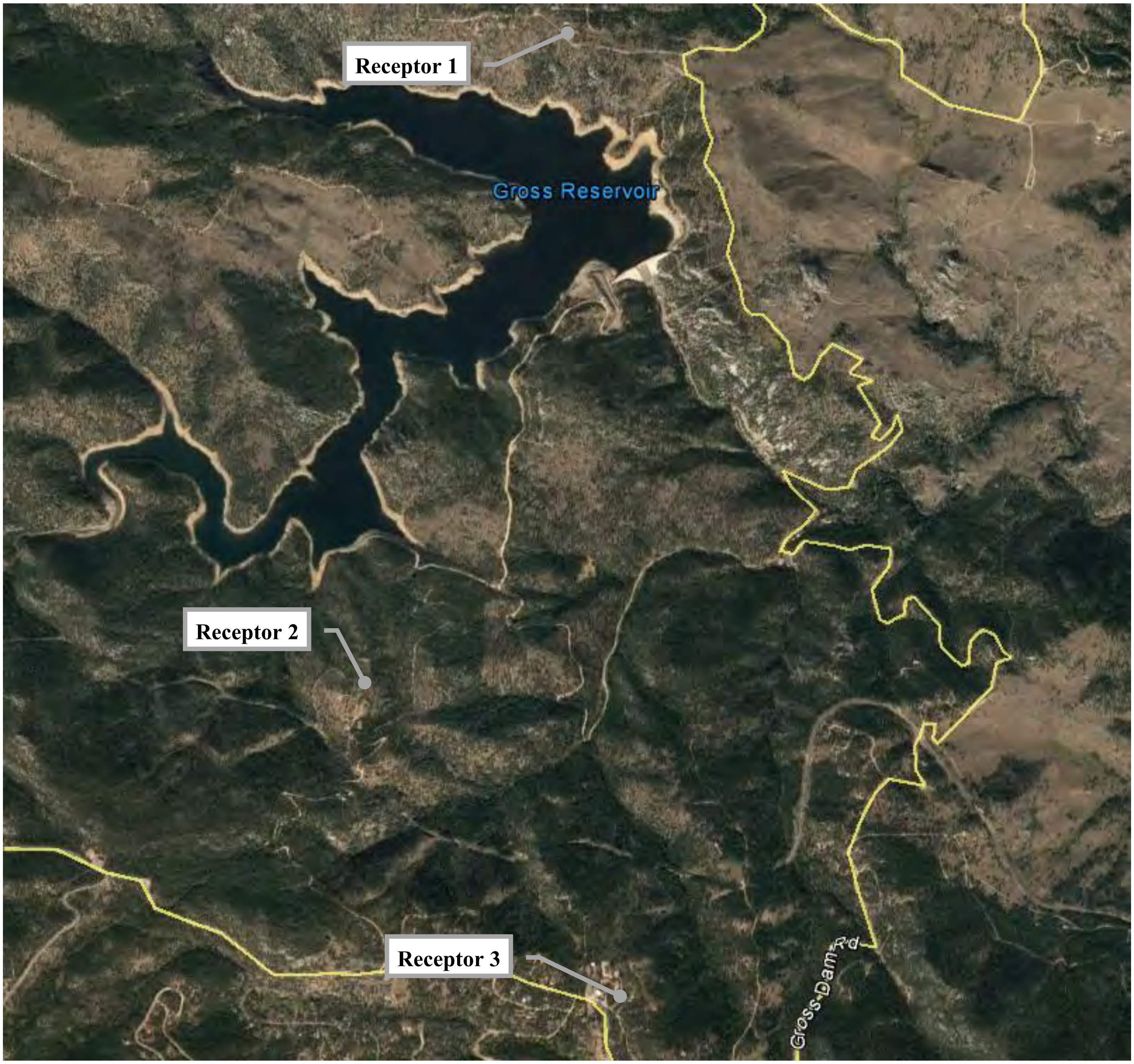

Figure 6-1 Receptor Locations

6.2 Modeled Noise Sources

The locations of each of the modeled noise generating activities are shown in Figure 2-1. Drilling and blasting locations were chosen based on the closest proximity and most favorable topography for sound propagation to the nearest residences and are shown in Figure 6-2.

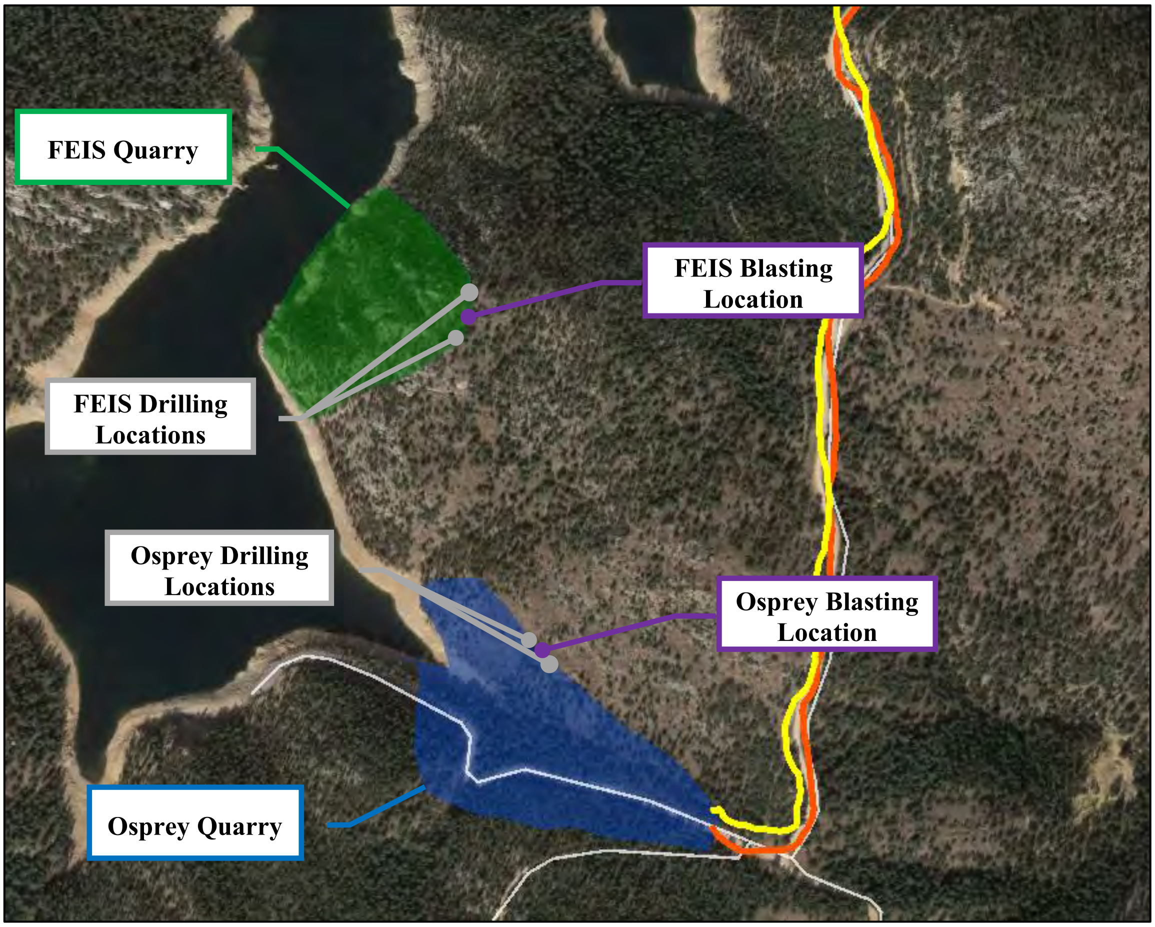

Figure 6-2 Drilling and Blasting Locations

The construction activities, quantities, data source and their respective sound power levels included in the modeling are shown in Table 6-3. The sound power levels for the Dam Construction were calculated based on the U.S Department of Transportation Federal Highway Administration Construction Noise Handbook. The usage factors used in the modeling for Dam Construction are shown in the data source/notes column.

Table 6-3 Quantities and Sound Power Levels of Noise Generating Equipment

Activity	Equipment	Quantity	Data Source/Notes	Individual Component Sound Power Level (dBA)
Drilling	Drilling Rig and Ancillary Equipment	2	Sound level survey	118.4
Aggregate Processing Plant (TEREX 3 Stage)	Jaw Crusher	1	Measured Data (LSA Associates)	112.1
	Cone Crusher	1	Measured Data (LSA Associates)	112.1
	Horizontal Screen	1	Measured Data (LSA Associates)	112.1
	VSI	1	Measured Data (LSA Associates)	112.1
	Diesel Generator (Cummins 150 kW)	5	Manufacturer Data	99.7
Haul Truck Route	Haul Trucks (35 Ton)	-	Calculation based on 16 trucks per hour	61.2 sound pressure level at 50 ft
Concrete Batch Plant (Twin Shaft Continuous Mixer, 250 cycles per hour)	Loader	1	Sound level survey	104.0
	Small Conveyor	2	Sound level survey	95.1
	Feed Hopper	1	Sound level survey	95.4
	Diesel Generator	5	Manufacturer Data	99.7
RCC Dam Construction	Boom Crane	2	FHWA, 16% Usage factor	119.0
	Small Hydraulic Crane	1	FHWA, 16% Usage factor	119.0
	Skid Steer	4	FHWA, 40% Usage factor	114.0
	Vibratory Roller	4	FHWA, 20% Usage factor	119.0
	Dozer	3	FHWA, 40% Usage factor	119.0
	Haul Truck	4	FHWA, 40% Usage factor	118.0
Shift Work Construction	Loader	1	FHWA, 40% Usage factor	114.0
	Skid Steer	4	FHWA, 40% Usage factor	114.0
	Boom Crane	2	FHWA, 16% Usage factor	119.0
	Diesel Generator	1	Manufacturer Data	99.7
Conveyor (Rock Systems 36 in x 1,000 ft)	Conveyor Drive (WEG 50 HP Electric Motor)	5	Manufacturer Data	101.0
	Conveyor Idler Rollers (Steel)	-	Measured Data (LSA Associates)	93.2 per meter
Blasting	Detonation of Charge	1	Sound level survey	136.9

To ensure that the noise impact is determined for the proposed construction activities and project alternatives, seven scenarios have been identified and included in the analysis. Each scenario has been chosen based on the loudest proposed activities occurring simultaneously during the day, evening and nighttime periods. Shift work construction occurring during the nighttime periods consists of preparation work the following day shift. The equipment operating during the shift work construction is shown in Table 6-3.

Construction associated with the Gross Dam will be occurring for three years. To represent Years 1-2, construction has been modeled at an elevation of 7,110 feet. For Year 3, construction has been modeled above the existing dam crest at an elevation of 7,280 feet. Results for Scenario 1, 2, 3, 6 and 7 has been provided for Years 1-2 and Year 3 of the project, taking into account the difference in elevation.

Blasting activities have been modeled separately from the other activities as blasting noise is impulsive in nature whereas the other activities modeled are assumed to emit relatively constant noise. The seven scenarios included in the noise modeling are summarized in Table 6-4. The drilling, blasting and the aggregate plant locations have been modeled at either the FEIS Quarry or the Osprey Quarry as indicated by the scenario name in Table 6-4.

Table 6-4 Modeling Scenarios

Scenario Description	Blasting	Drilling	Aggregate Processing Plant	Haul Truck Route	Conveyor	Batch Plant	RCC Dam Construction	Shift Work Construction
1. FEIS Quarry Daytime with Haul Trucks		●	●	●		●	●	
2. Osprey Quarry Daytime with Haul Trucks		●	●	●		●	●	
3. Osprey Quarry Daytime with Conveyor		●	●		●	●	●	
4. FEIS Quarry Daytime Blasting	●							
5. Osprey Quarry Daytime Blasting	●							
6. Construction Evening						●	●	
7. Shift Work Construction Nighttime								●

6.3 Daytime Noise Modeling Results

The results of the noise modeling for the Year 1-2 and Year 3 daytime scenarios are shown in Table 6-5 and Table 6-6. The locations in the table correspond to the receptor locations shown in Figure 6-1. The scenario description corresponds with the modeling scenarios shown in Table 6-4. The predicted noise levels represent only the contribution of the construction activities and do not include ambient noise or noise from other facilities. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other facilities, other human activity, or environmental factors. The modeling conducted for Scenarios 1 to 3 represents numerous construction activities occurring simultaneously, reflecting the loudest period of operation during the daytime hours of the project.

Table 6-5 Daytime Noise Modeling Results for Years 1-2 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
1. FEIS Quarry Daytime with Haul Trucks	33.7	42.4	33.4
2. Osprey Quarry Daytime with Haul Trucks	30.9	47.0	34.1
3. Osprey Quarry Daytime with Conveyor	41.2	48.9	36.8
State and County Noise Limit	**80.0**	**80.0**	**80.0**

Table 6-6 Daytime Noise Modeling Results for Year 3 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
1. FEIS Quarry Daytime with Haul Trucks	45.0	43.0	33.6
2. Osprey Quarry Daytime with Haul Trucks	44.8	47.2	34.3
3. Osprey Quarry Daytime with Conveyor	46.3	49.0	36.9
State and County Noise Limit	**80.0**	**80.0**	**80.0**

The noise contour maps for Scenarios 1 to 3 are shown in Appendix F - Noise Contour Maps.

6.4 Blasting Noise Modeling Results

The results of the noise modeling for the blasting scenarios are shown in Table 6-7. The noise modeling results represent an instantaneous noise level that would occur when the charges are detonated once per day during daytime hours. The predicted noise levels represent only the contribution of the blasting activities and do not include ambient noise or noise from other facilities. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other facilities, other human activity, or environmental factors.

Table 6-7 Instantaneous Blasting Noise Modeling Results (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
4. FEIS Quarry Daytime Blasting	51.2	55.9	46.9
5. Osprey Quarry Daytime Blasting	34.1	64.4	49.4
State and County Noise Limit	**75.0**	**75.0**	**75.0**

The noise contour maps for Scenarios 4 and 5 are shown in Appendix F - Noise Contour Maps.

6.5 Evening and Nighttime Noise Modeling Results

The results of the noise modeling for the Year 1-2 and Year 3 evening and nighttime scenarios are shown in Table 6-8 and Table 6-9. The predicted noise levels represent only the contribution of the construction activities and do not include ambient noise or noise from other facilities. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other facilities, other human activity, or environmental factors. The modeling conducted for Scenarios 6 and 7 represents reduced construction activities expected to occur during the evening and nighttime periods of the project.

Table 6-8 Evening and Nighttime Noise Modeling Results for Years 1-2 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
6. Construction Evening	30.6	30.1	32.3
7. Shift Work Construction Nighttime	22.5	20.5	24.2
State and County Noise Limit	**75.0**	**75.0**	**75.0**

Table 6-9 Evening and Nighttime Noise Modeling Results for Year 3 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
6. Construction Evening	44.8	35.5	32.6
7. Shift Work Construction Nighttime	38.1	28.3	25.5
State and County Noise Limit	**75.0**	**75.0**	**75.0**

The noise contour maps for Scenarios 6 and 7 are shown in Appendix F - Noise Contour Maps.

7. Mitigation Recommendations and Discussion

The predicted noise levels at the receptors due to project related activities for Scenarios 1 to 3 range between 30.9 dBA and 49.0 dBA. The predicted noise levels at the receptors due to project related activities for Scenarios 6 and 7 range between 20.5 dBA and 44.8 dBA. Generally speaking, noise levels within these ranges are representative of a quiet urban environment as shown in Figure 3-1. It is expected that inside residences, noise levels will be significantly lower and are not likely to be intrusive.

The noise modeling results presented in Section 6.3 for Scenario 2- Osprey Quarry Daytime with Haul Trucks and Scenario 3- Osprey Quarry Daytime with Conveyor show that the conveyor is louder than using haul trucks. Noise from the haul trucks has been calculated based on an hourly noise level. Realistically, there will be short periods during the hour where noise levels from the haul trucks are above or below the modeled noise level. This variation has been accounted for in the calculation of the hourly noise level.

The conveyor noise however, has been modeled as a constant noise source as little variation in noise levels are expected. To reduce noise from the conveyor, aluminum idler rollers should be used in place of previously modeled steel idler rollers. The sound power level of the conveyor with aluminum idler rollers would be 86.0 dBA per meter (Brown, S.C.). The modeled noise levels with the steel idler rollers are reproduced in Table 7-1 along with additional modeling conducted which includes replacing the steel idler rollers with aluminum idler rollers. The noise contour map for Scenario 3 with aluminum idler rollers is shown in Appendix F - Noise Contour Maps.

Table 7-1 Scenario 3 with Steel and Aluminum Rollers for Years 1-2 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
3. Osprey Quarry Daytime with Conveyor (steel idler rollers)	41.2	48.9	36.8
3. Osprey Quarry Daytime with Conveyor (aluminum idler rollers)	35.4	47.3	34.7
State and County Noise Limit	**80.0**	**80.0**	**80.0**

Table 7-2 Scenario 3 with Steel and Aluminum Rollers for Year 3 (dBA)

Scenario Description	Receptor 1	Receptor 2	Receptor 3
3. Osprey Quarry Daytime with Conveyor (steel idler rollers)	46.3	49.0	36.9
3. Osprey Quarry Daytime with Conveyor (aluminum idler rollers)	45.2	47.5	34.8
State and County Noise Limit	**80.0**	**80.0**	**80.0**

The ambient sound survey conducted from February 22 to March 1, 2017 is during winter when there is less activity occurring in the area. Additionally, temperatures are significantly lower during this period which are generally less favorable for noise propagation. As a result, ambient noise levels are expected to be lower during winter. The Gross Dam project is scheduled to occur during summer months where ambient noise levels would be higher.

8. Conclusion

An ambient survey was conducted at the residential areas adjacent to the Gross Dam project from February 22 to March 1, 2017. Three receptors were included in the modeling to represent the residential areas adjacent to the project. Seven scenarios were modeled to determine the noise impact on the receptors during the daytime, evening and nighttime for different quarry locations and project alternatives. Noise levels were predicted based on Years 1-2 and Year 3 of the project to account for the variation in elevation of the construction equipment.

To reduce noise levels for Scenario 3- Osprey Quarry Daytime with Conveyor it is recommended that aluminum idler rollers are used in place of steel idler rollers.

9. References

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Appendix A - Glossary of Acoustical Terms

Ambient Noise
The all-encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources both near and far.

Average Sound Level
See Equivalent-Continuous Sound Level

A-Weighted Sound Level, dB(A)
The sound level obtained by use of A-weighting. Weighting systems were developed to measure sound ina way that more closely mimics the ear's natural sensitivity relative to frequency so that the instrument is less sensitive to noise at frequencies where the human ear is less sensitive and more sensitive at frequencies where the human ear is more sensitive.

C-Weighted Sound Level, dBC
The sound level obtained by use of C-weighting. Follows the frequency sensitivity of the human ear at very high noise levels. The C-weighting scale is quite flat and therefore includes much more of the low-frequency range of sounds than the A and B scales. In some jurisdictions, C-weighted sound limits are used to limit the low-frequency content of noise sources.

Community Noise Equivalent Level (CNEL)
A 24-hour A-weighted average sound level which takes into account the fact that a given level of noise may be more or less tolerable depending on when it occurs. The CNEL measure of noise exposure weights average hourly noise levels by 5 dB for the evening hours (between 7:00 pm and 10:00 pm), and 10 dB between 10:00 pm and 7:00 am, then combines the results with the daytime levels to produce the final CNEL value. It is measured in decibels, dB.

Day-Night Average Sound Level (Ldn)
A measure of noise exposure level that is similar to CNEL except that there is no weighting applied to the evening hours of 7:00 pm to 10:00 pm. It is measured in decibels, dB.

Daytime Average Sound Level
The time-averaged A-weighted sound level measured between the hours of 7:00 am to 7:00 pm. It is measured in decibels, dB.

Decay Rate
The time taken for the sound pressure level at a given frequency to decrease in a room. It is measured in decibels per second, dB/s.

Decibel (dB)
The basic unit of measurement for sound level.

Direct Sound
Sound that reaches a given location in a direct line from the source without any reflections.

Divergence
The spreading of sound waves from a source in a free field, resulting in a reduction in sound pressure level with increasing distance from the source.

Energy Basis
This refers to the procedure of summing or averaging sound pressure levels on the basis of their squared pressures. This method involves the conversion of decibels to pressures, then performing the necessary arithmetic calculations, and finally changing the pressure back to decibels.

Equivalent-Continuous Sound Level (Leq)
The average sound level measured over a specified time period. It is a single-number measure of time-varying noise over a specified time period. It is the level of a steady sound that, in a stated time period and at a stated location, has the same A-Weighted sound energy as the time-varying sound. For example, a person who experiences an Leq of 60 dB(A) for a period of 10 minutes standing next to a busy street is exposed to the same amount of sound energy as if he had experienced a constant noise level of 60 dB(A) for 10 minutes rather than the time-varying traffic noise level. It is measured in decibels, dB.

Fast Response
A setting on the sound level meter that determines how sound levels are averaged over time. A fast sound level is always more strongly influenced by recent sounds, and less influenced by sounds occurring in the distant past, than the corresponding slow sound level. For the same non-steady sound, the maximum fast sound level is generally greater than the corresponding maximum slow sound level. Fast response is typically used to measure impact sound levels.

Field Impact Insulation Class (FIIC)
A single number rating similar to the impact insulation class except that the impact sound pressure levels are measured in the field.

Field Sound Transmission Class (FSTC)
A single number rating similar to sound transmission class except that the transmission loss values used to derive this class are measured in the field.

Flanking Sound Transmission
The transmission of sound from a room in which a source is located to an adjacent receiving room by paths other than through the common partition. Also, the diffraction of noise around the ends of a barrier.

Frequency
The number of oscillations per second of a sound wave

Hourly Average Sound Level (HNL)
The equivalent-continuous sound level, Leq, over a 1-hour time period.

Impact Insulation Class (IIC)
A single number rating used to compare the effectiveness of floor/ceiling assemblies in providing reduction of impact-generated sound such as the sound of a person's walking across the upstairs floor.

Impact Noise
The noise that results when two objects collide.

Impulse Noise
Noise of a transient nature due to the sudden impulse of pressure like that created by a gunshot or balloon bursting.

Insertion Loss
The decrease in sound power level measured at the location of the receiver when an element (e.g., a noise barrier) is inserted in the transmission path between the sound source and the receiver.

Inverse Square Law
A rule by which the sound intensity varies inversely with the square of the distance from the source. This results in a 6dB decrease in sound pressure level for each doubling of distance from the source.

L_n Sound Level
Time-varying noise environments may be expressed in terms of the noise level that is exceeded for a certain percentage of the total measurement time. These statistical noise levels are denoted L_n, where n is the percent of time. For example, the L_{50} is the noise level exceeded for 50% of the time. For a 1-hour measurement period, the L_{50} would be the noise level exceeded for a cumulative period of 30 minutes in that hour.

Masking
The process by which the threshold of hearing for one sound is raised by the presence of another sound.

Maximum Sound Level (Lmax)
The greatest sound level measured on a sound level meter during a designated time interval or event.

NC Curves (Noise Criterion Curves)
A system for rating the noisiness of an occupied indoor space. An actual octave-band spectrum is compared with a set of standard NC curves to determine the NC level of the space.

Noise Reduction
The difference in sound pressure level between any two points.

Noise Reduction Coefficient (NRC)
A single number rating of the sound absorption properties of a material. It is the average of the sound absorption coefficients at 250, 500, 1000, and 2000 Hz, rounded to the nearest multiple of 0.05.

Octave
The frequency interval between two sounds whose frequency ratio is 2. For example, the frequency interval between 500 Hz and 1,000 Hz is one octave.

Octave-Band Sound Level
For an octave frequency band, the sound pressure level of the sound contained within that band.

One-Third Octave
The frequency interval between two sounds whose frequency ratio is 2^(1/3). For example, the frequency interval between 200 Hz and 250 Hz is one-third octave.

One-Third-Octave-Band Sound Level
For a one-third-octave frequency band, the sound pressure level of the sound contained within that band.

Outdoor-Indoor Transmission Class (OITC)
A single number rating used to compare the sound insulation properties of building façade elements. This rating is designed to correlate with subjective impressions of the ability of façade elements to reduce the overall loudness of ground and air transportation noise.

Peak Sound Level (Lpk)
The maximum instantaneous sound level during a stated time period or event.

Pink Noise
Noise that has approximately equal intensities at each octave or one-third-octave band.

Point Source
A source that radiates sound as if from a single point.

RC Curves (Room Criterion Curves)
A system for rating the noisiness of an occupied indoor space. An actual octave-band spectrum is compared with a set of standard RC curves to determine the RC level of the space.

Real-Time Analyzer (RTA)
An instrument for the determination of a sound spectrum.

Receiver
A person (or persons) or equipment which is affected by noise.

Reflected Sound
Sound that persists in an enclosed space as a result of repeated reflections or scattering. It does not include sound that travels directly from the source without reflections.

Reverberation
The persistence of a sound in an enclosed or partially enclosed space after the source of the sound has stopped, due to the repeated reflection of the sound waves.

Room Absorption
The total absorption within a room due to all objects, surfaces and air absorption within the room. It is measured in Sabins or metric Sabins.

Slow Response
A setting on the sound level meter that determines how measured sound levels are averaged over time. A slow sound level is more influenced by sounds occurring in the distant past that the corresponding fast sound level.

Sound
A physical disturbance in a medium (e.g., air) that is capable of being detected by the human ear.

Sound Absorption Coefficient
A measure of the sound-absorptive property of a material.

Sound Insulation
The capacity of a structure or element to prevent sound from reaching a receiver room either by absorption or reflection.

Sound Level Meter (SLM)
An instrument used for the measurement of sound level, with a standard frequency-weighting and standard exponentially weighted time averaging.

Sound Power Level
A physical measure of the amount of power a sound source radiates into the surrounding air. It is measured in decibels.

Sound Pressure Level
A physical measure of the magnitude of a sound. It is related to the sound's energy. The terms sound pressure level and sound level are often used interchangeably.

Sound Transmission Class (STC)
A single number rating used to compare the sound insulation properties of walls, floors, ceilings, windows, or doors. This rating is designed to correlate with subjective impressions of the ability of building elements to reduce the overall loudness of speech, radio, television, and similar noise sources in offices and buildings.

Source Room
A room that contains a noise source or sources

Spectrum
The spectrum of a sound wave is a description of its resolution into components, each of different frequency and usually different amplitude.

Tapping Machine
A device used in rating different floor constructions against impacts. It produces a series of impacts on the floor under test, 10 times per second.

Tone
A sound with a distinct pitch

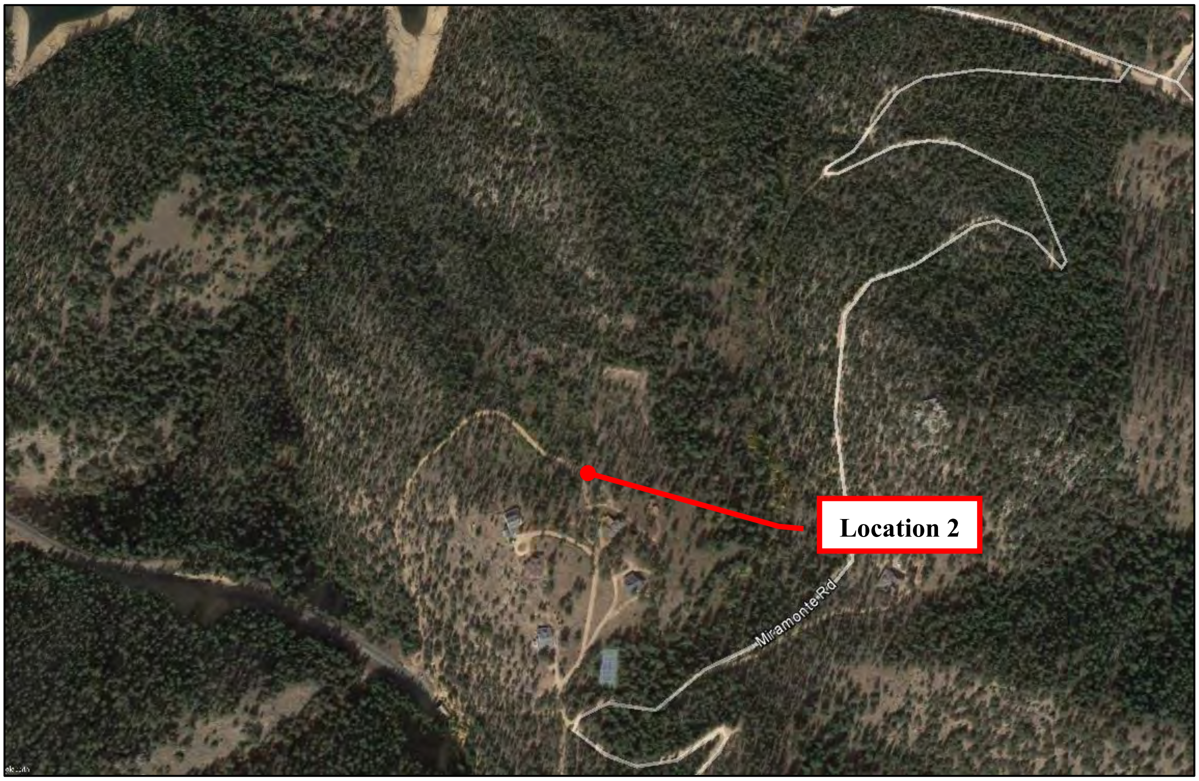
Transmission Loss (TL)
A property of a material or structure describing its ability to reduce the transmission of sound at a particular frequency from one space to another. The higher the TL value the more effective the material or structure is in reducing sound between two spaces. It is measured in decibels.

White Noise
Noise that has approximately equal intensities at all frequencies.

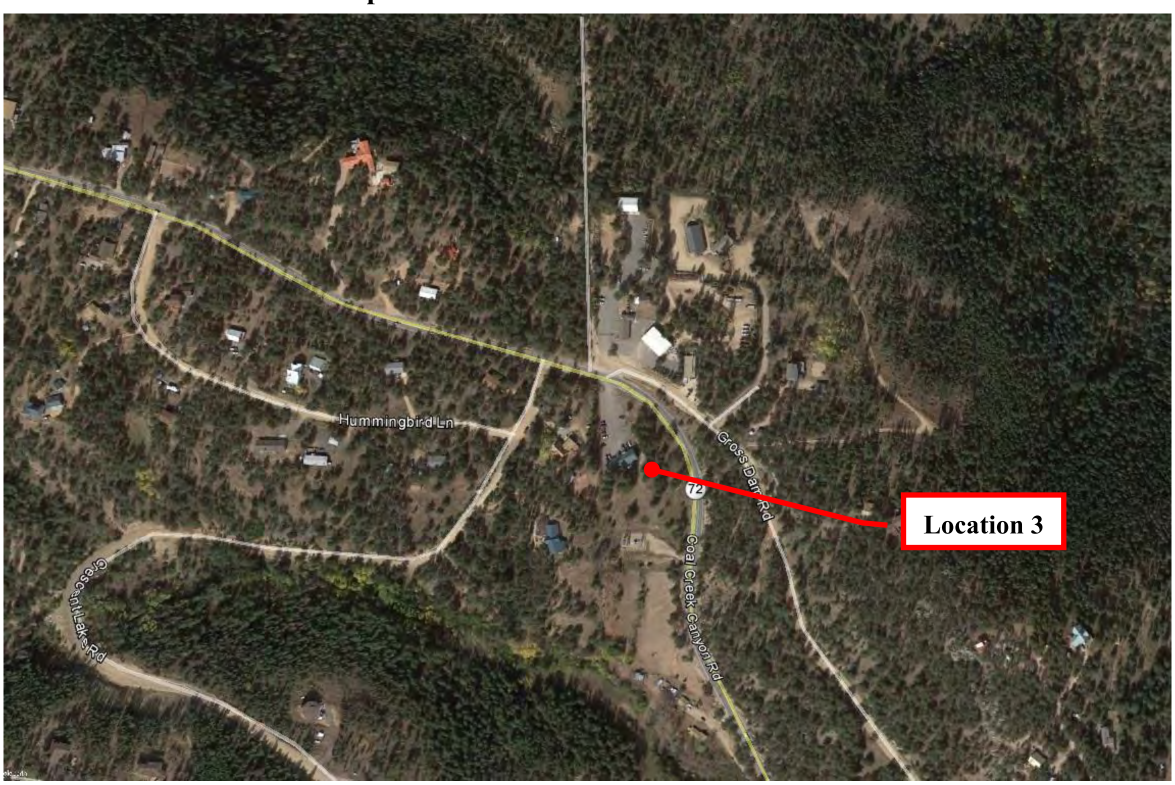
Windscreen
A porous covering for a microphone, designed to reduce the noise generated by the passage of wind over the microphone.

Appendix B - Ambient Survey Locations

Map of Ambient Measurement Location 1



Map of Ambient Measurement Location 2



Map of Ambient Measurement Location 3

Appendix C - Tabulated Weather Data

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/22/2017 15:00	44	41	4	NNE
2/22/2017 15:15	43.2	41	5	NNE
2/22/2017 15:30	42.5	43	4	NNE
2/22/2017 15:45	42.8	43	3	NNE
2/22/2017 16:00	42.9	43	1	NE
2/22/2017 16:15	42.3	43	2	NE
2/22/2017 16:30	41.9	43	3	NNE
2/22/2017 16:45	41.4	44	2	NNE
2/22/2017 17:00	40.7	44	1	NE
2/22/2017 17:15	40.1	45	1	ENE
2/22/2017 17:30	39.6	45	1	ENE
2/22/2017 17:45	38.7	47	1	NE
2/22/2017 18:00	38.1	46	1	NE
2/22/2017 18:15	37.8	47	0	ENE
2/22/2017 18:30	37.1	48	1	NE
2/22/2017 18:45	35.8	51	1	NNE
2/22/2017 19:00	34.4	54	1	NNE
2/22/2017 19:15	33.4	57	0	NE
2/22/2017 19:30	32.8	59	0	ENE
2/22/2017 19:45	32.4	61	0	ENE
2/22/2017 20:00	32	63	0	---
2/22/2017 20:15	32.2	63	0	ENE
2/22/2017 20:30	31.8	65	0	NNE
2/22/2017 20:45	31.3	66	0	---
2/22/2017 21:00	30.4	65	0	NNE
2/22/2017 21:15	29.9	67	0	NNE
2/22/2017 21:30	29.3	69	0	---
2/22/2017 21:45	29.3	67	0	---
2/22/2017 22:00	29.4	67	0	ENE
2/22/2017 22:15	29.1	67	0	NNE
2/22/2017 22:30	28	74	0	ENE
2/22/2017 22:45	27	79	0	ENE
2/22/2017 23:00	26.4	81	0	ENE
2/22/2017 23:15	25.7	82	0	NNE
2/22/2017 23:30	25.2	82	0	---
2/22/2017 23:45	25	82	0	---
2/23/2017 0:00	25.1	82	0	---
2/23/2017 0:15	24.5	83	0	---
2/23/2017 0:30	24.3	82	0	NE
2/23/2017 0:45	24.8	79	0	---
2/23/2017 1:00	25.4	80	0	NNE
2/23/2017 1:15	25.5	80	0	NE
2/23/2017 1:30	25.3	80	0	---
2/23/2017 1:45	25.1	81	0	NE
2/23/2017 2:00	24.9	80	0	ENE
2/23/2017 2:15	24.5	82	0	ENE
2/23/2017 2:30	24.2	85	0	ENE
2/23/2017 2:45	23.6	87	0	ENE
2/23/2017 3:00	23.6	87	0	ENE
2/23/2017 3:15	23.6	87	0	NNE
2/23/2017 3:30	23.4	88	0	NNE
2/23/2017 3:45	23	90	0	NNE
2/23/2017 4:00	22.7	91	1	NNE
2/23/2017 4:15	22.4	92	1	NNE

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/23/2017 4:30	22.3	93	1	NNE
2/23/2017 4:45	21.9	93	1	NNE
2/23/2017 5:00	22	92	0	NNE
2/23/2017 5:15	21.8	92	0	NW
2/23/2017 5:30	21.6	92	0	NNE
2/23/2017 5:45	21.5	92	0	NNE
2/23/2017 6:00	21.6	92	0	NNE
2/23/2017 6:15	21.4	92	0	NW
2/23/2017 6:30	21.3	92	0	NW
2/23/2017 6:45	21.2	92	0	WNW
2/23/2017 7:00	21.2	92	0	WNW
2/23/2017 7:15	21.3	92	0	NW
2/23/2017 7:30	21.3	92	0	WNW
2/23/2017 7:45	21.5	92	0	N
2/23/2017 8:00	21.9	92	0	---
2/23/2017 8:15	22	92	0	NW
2/23/2017 8:30	21.6	91	0	NNE
2/23/2017 8:45	21.5	92	0	NNE
2/23/2017 9:00	20.9	91	0	NW
2/23/2017 9:15	20.9	92	0	NW
2/23/2017 9:30	20.9	92	0	NW
2/23/2017 9:45	21	92	0	WNW
2/23/2017 10:00	21.3	92	0	W
2/23/2017 10:15	21.4	92	0	WNW
2/23/2017 10:30	21.8	92	0	WNW
2/23/2017 10:45	22.3	91	0	WNW
2/23/2017 11:00	22.8	91	0	NNE
2/23/2017 11:15	22.8	91	0	SW
2/23/2017 11:30	22.9	91	0	NNE
2/23/2017 11:45	23	91	0	NW
2/23/2017 12:00	22.8	90	0	NNE
2/23/2017 12:15	23.5	91	0	NNE
2/23/2017 12:30	23.4	90	0	NNE
2/23/2017 12:45	23.4	91	0	NNE
2/23/2017 13:00	22.6	90	0	NNE
2/23/2017 13:15	22.2	90	0	NNE
2/23/2017 13:30	21.9	91	0	NNE
2/23/2017 13:45	21	91	0	NNE
2/23/2017 14:00	20.8	91	0	NNE
2/23/2017 14:15	20.6	91	0	NNE
2/23/2017 14:30	20.8	91	0	NNE
2/23/2017 14:45	20.3	90	0	NNE
2/23/2017 15:00	18.9	88	1	NNE
2/23/2017 15:15	17.8	89	0	NNE
2/23/2017 15:30	16.6	89	0	NNE
2/23/2017 15:45	16.4	89	0	NNE
2/23/2017 16:00	16.4	89	0	---
2/23/2017 16:15	16.5	88	0	NW
2/23/2017 16:30	15.6	88	0	NNE
2/23/2017 16:45	14.9	88	0	N
2/23/2017 17:00	13.9	88	0	NNE
2/23/2017 17:15	13.3	89	0	NE
2/23/2017 17:30	13.2	89	0	NNE
2/23/2017 17:45	12.7	89	0	NNE

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/23/2017 18:00	12.4	89	0	NNE
2/23/2017 18:15	12	89	0	NNE
2/23/2017 18:30	11.8	89	0	NNE
2/23/2017 18:45	11.5	89	0	NNE
2/23/2017 19:00	11.2	89	0	NNE
2/23/2017 19:15	11	89	0	NNE
2/23/2017 19:30	10.9	89	0	N
2/23/2017 19:45	10.4	88	0	---
2/23/2017 20:00	9.9	88	0	N
2/23/2017 20:15	9.5	88	0	N
2/23/2017 20:30	9.3	88	0	---
2/23/2017 20:45	9.1	88	0	---
2/23/2017 21:00	8.9	88	0	---
2/23/2017 21:15	9	88	0	---
2/23/2017 21:30	8.9	88	0	---
2/23/2017 21:45	8.8	88	0	NNE
2/23/2017 22:00	8.7	88	0	---
2/23/2017 22:15	8.5	88	0	---
2/23/2017 22:30	8.3	88	0	---
2/23/2017 22:45	8.2	88	0	---
2/23/2017 23:00	8.1	88	0	---
2/23/2017 23:15	8	88	0	---
2/23/2017 23:30	7.5	87	0	---
2/23/2017 23:45	7	87	0	---
2/24/2017 0:00	6.6	87	0	---
2/24/2017 0:15	6.5	87	0	---
2/24/2017 0:30	6.1	87	0	---
2/24/2017 0:45	5.4	87	0	---
2/24/2017 1:00	4.9	87	0	---
2/24/2017 1:15	4.8	87	0	---
2/24/2017 1:30	4.1	86	0	---
2/24/2017 1:45	3.5	86	0	---
2/24/2017 2:00	3.5	87	0	---
2/24/2017 2:15	4.9	90	0	---
2/24/2017 2:30	5.8	89	0	---
2/24/2017 2:45	6	88	0	---
2/24/2017 3:00	6.2	89	0	---
2/24/2017 3:15	6.4	88	0	---
2/24/2017 3:30	6.5	88	0	---
2/24/2017 3:45	6.6	88	0	---
2/24/2017 4:00	6.7	88	0	---
2/24/2017 4:15	6.7	88	0	---
2/24/2017 4:30	6.9	88	0	---
2/24/2017 4:45	7.2	89	0	---
2/24/2017 5:00	7.3	88	0	---
2/24/2017 5:15	7.4	88	0	---
2/24/2017 5:30	7.4	88	0	---
2/24/2017 5:45	7.5	88	0	---
2/24/2017 6:00	7.5	88	0	---
2/24/2017 6:15	7.5	88	0	---
2/24/2017 6:30	7.6	88	0	---
2/24/2017 6:45	7.5	88	0	---
2/24/2017 7:00	7.4	88	0	---
2/24/2017 7:15	7.7	88	0	---

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/24/2017 7:30	8	88	0	---
2/24/2017 7:45	8.5	88	0	---
2/24/2017 8:00	9.2	88	0	NE
2/24/2017 8:15	8.8	87	0	NE
2/24/2017 8:30	9.3	88	0	WNW
2/24/2017 8:45	9.9	88	0	NE
2/24/2017 9:00	9.9	86	0	NNE
2/24/2017 9:15	10.7	87	0	NE
2/24/2017 9:30	11	86	0	NE
2/24/2017 9:45	11	87	0	NNE
2/24/2017 10:00	11.7	86	0	NNE
2/24/2017 10:15	12.4	83	0	NNE
2/24/2017 10:30	12.6	84	0	NNE
2/24/2017 10:45	12.9	83	0	---
2/24/2017 11:00	13.7	84	0	ENE
2/24/2017 11:15	13.9	83	0	NNE
2/24/2017 11:30	13.6	82	0	NE
2/24/2017 11:45	13.6	84	0	NE
2/24/2017 12:00	13.6	84	0	NNE
2/24/2017 12:15	12.8	84	0	NNE
2/24/2017 12:30	13.2	84	0	NNE
2/24/2017 12:45	13	85	0	NNE
2/24/2017 13:00	12.4	85	0	NNE
2/24/2017 13:15	12.9	86	0	N
2/24/2017 13:30	13	85	0	N
2/24/2017 13:45	12.8	85	0	N
2/24/2017 14:00	13.2	85	0	NE
2/24/2017 14:15	13.3	85	0	NNE
2/24/2017 14:30	13.3	86	0	NNE
2/24/2017 14:45	12.5	85	0	NNE
2/24/2017 15:00	11.9	87	0	NE
2/24/2017 15:15	12.1	87	0	---
2/24/2017 15:30	12.8	86	0	---
2/24/2017 15:45	12.1	87	0	---
2/24/2017 16:00	12.3	87	0	---
2/24/2017 16:15	12.2	88	0	---
2/24/2017 16:30	11.7	88	0	---
2/24/2017 16:45	11.4	88	0	NE
2/24/2017 17:00	11.1	89	0	NE
2/24/2017 17:15	11.2	89	0	---
2/24/2017 17:30	10.8	87	0	---
2/24/2017 17:45	9.6	85	0	---
2/24/2017 18:00	9.4	89	0	---
2/24/2017 18:15	9.9	90	0	---
2/24/2017 18:30	9.6	89	0	---
2/24/2017 18:45	8.9	88	0	---
2/24/2017 19:00	8.9	89	0	---
2/24/2017 19:15	7.8	87	0	---
2/24/2017 19:30	6.4	85	0	---
2/24/2017 19:45	5.8	89	0	---
2/24/2017 20:00	5.1	86	0	---
2/24/2017 20:15	4.5	87	0	---
2/24/2017 20:30	4.6	88	0	---
2/24/2017 20:45	4.7	89	0	---

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/24/2017 21:00	7.6	90	0	SW
2/24/2017 21:15	9.7	86	0	---
2/24/2017 21:30	10	83	0	E
2/24/2017 21:45	10.3	81	0	WSW
2/24/2017 22:00	10.4	80	0	NNE
2/24/2017 22:15	10.4	78	0	---
2/24/2017 22:30	10.2	77	0	---
2/24/2017 22:45	9.6	77	0	---
2/24/2017 23:00	9.4	78	0	SW
2/24/2017 23:15	9.5	79	0	W
2/24/2017 23:30	9.5	79	0	ESE
2/24/2017 23:45	9.5	78	0	ESE
2/25/2017 0:00	8.9	78	0	W
2/25/2017 0:15	9.9	78	0	WSW
2/25/2017 0:30	10.5	77	1	WSW
2/25/2017 0:45	10.7	75	2	W
2/25/2017 1:00	10.6	73	1	WSW
2/25/2017 1:15	10.5	72	1	W
2/25/2017 1:30	10.4	72	1	W
2/25/2017 1:45	10.3	72	2	WSW
2/25/2017 2:00	10.3	71	2	WSW
2/25/2017 2:15	10.2	69	3	WSW
2/25/2017 2:30	10.2	69	2	WSW
2/25/2017 2:45	10.1	69	3	WSW
2/25/2017 3:00	10.1	68	3	WSW
2/25/2017 3:15	10	69	2	W
2/25/2017 3:30	10	68	2	W
2/25/2017 3:45	9.7	68	2	WSW
2/25/2017 4:00	9.7	68	1	W
2/25/2017 4:15	9.7	68	2	W
2/25/2017 4:30	9.6	68	1	W
2/25/2017 4:45	9.7	66	2	WSW
2/25/2017 5:00	9.8	66	2	WSW
2/25/2017 5:15	10.2	64	3	WSW
2/25/2017 5:30	10.3	63	3	W
2/25/2017 5:45	10.2	62	2	W
2/25/2017 6:00	10.6	60	3	W
2/25/2017 6:15	10.6	59	2	W
2/25/2017 6:30	10.5	59	2	WSW
2/25/2017 6:45	10.2	59	1	WSW
2/25/2017 7:00	9.7	59	0	WSW
2/25/2017 7:15	9.9	60	1	WSW
2/25/2017 7:30	10.2	58	0	W
2/25/2017 7:45	11.1	57	1	WSW
2/25/2017 8:00	11.7	56	1	WSW
2/25/2017 8:15	12.4	56	1	WSW
2/25/2017 8:30	13.4	53	1	WSW
2/25/2017 8:45	14.3	54	1	WSW
2/25/2017 9:00	15.7	52	0	WSW
2/25/2017 9:15	16.8	49	1	WSW
2/25/2017 9:30	17.1	48	2	W
2/25/2017 9:45	18.1	47	1	W
2/25/2017 10:00	19.2	47	1	WSW
2/25/2017 10:15	19.7	45	1	WSW

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/25/2017 10:30	19.8	42	1	WSW
2/25/2017 10:45	20.5	44	1	W
2/25/2017 11:00	20.7	43	1	WSW
2/25/2017 11:15	20.8	42	2	W
2/25/2017 11:30	21.8	43	1	WSW
2/25/2017 11:45	22.3	40	1	WSW
2/25/2017 12:00	22.1	41	1	WSW
2/25/2017 12:15	21.6	42	1	WSW
2/25/2017 12:30	21.3	39	2	WNW
2/25/2017 12:45	20.5	43	3	W
2/25/2017 13:00	20.6	42	4	WNW
2/25/2017 13:15	20	41	6	WSW
2/25/2017 13:30	20.1	41	4	W
2/25/2017 13:45	20.2	42	5	W
2/25/2017 14:00	20.6	45	5	W
2/25/2017 14:15	20.3	47	6	WSW
2/25/2017 14:30	19.9	45	6	W
2/25/2017 14:45	19.9	46	4	W
2/25/2017 15:00	19.2	45	4	WSW
2/25/2017 15:15	18.8	49	3	W
2/25/2017 15:30	17.9	54	2	W
2/25/2017 15:45	18.1	53	1	W
2/25/2017 16:00	17.9	53	1	WSW
2/25/2017 16:15	17.8	54	0	WNW
2/25/2017 16:30	17.5	48	0	WSW
2/25/2017 16:45	17.6	47	0	WSW
2/25/2017 17:00	17.5	46	0	SW
2/25/2017 17:15	17.2	49	0	SSW
2/25/2017 17:30	16.8	49	0	SW
2/25/2017 17:45	16.2	54	0	WSW
2/25/2017 18:00	15.7	55	0	WSW
2/25/2017 18:15	15.4	56	0	WSW
2/25/2017 18:30	15.3	57	0	ENE
2/25/2017 18:45	15.2	57	0	SW
2/25/2017 19:00	15.5	56	0	SSW
2/25/2017 19:15	15.5	56	0	SE
2/25/2017 19:30	15.7	53	0	SW
2/25/2017 19:45	15.8	56	0	SW
2/25/2017 20:00	16	57	0	WNW
2/25/2017 20:15	16.4	59	0	WNW
2/25/2017 20:30	16	67	0	W
2/25/2017 20:45	16	65	1	WSW
2/25/2017 21:00	15.9	61	2	WSW
2/25/2017 21:15	16.1	57	2	NW
2/25/2017 21:30	15.8	53	1	NW
2/25/2017 21:45	15.1	54	0	SW
2/25/2017 22:00	14.8	55	1	WSW
2/25/2017 22:15	15.5	52	3	WSW
2/25/2017 22:30	15.4	52	3	WNW
2/25/2017 22:45	15.7	49	3	WNW
2/25/2017 23:00	15.7	50	3	W
2/25/2017 23:15	15.2	50	2	W
2/25/2017 23:30	14.8	51	2	WNW
2/25/2017 23:45	14.5	51	1	WSW

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/26/2017 0:00	14.7	50	1	W
2/26/2017 0:15	14.9	47	2	W
2/26/2017 0:30	14.7	49	3	W
2/26/2017 0:45	14.5	50	3	W
2/26/2017 1:00	14.4	51	3	WNW
2/26/2017 1:15	14.3	49	2	WSW
2/26/2017 1:30	14	50	3	WNW
2/26/2017 1:45	14.1	49	3	WNW
2/26/2017 2:00	14.6	42	3	W
2/26/2017 2:15	14.9	44	4	W
2/26/2017 2:30	14.3	47	4	WSW
2/26/2017 2:45	14	47	3	W
2/26/2017 3:00	14	46	4	WSW
2/26/2017 3:15	13.9	45	3	W
2/26/2017 3:30	13.5	47	3	W
2/26/2017 3:45	13.3	46	2	W
2/26/2017 4:00	13.3	46	2	W
2/26/2017 4:15	13.2	46	3	W
2/26/2017 4:30	12.9	46	2	W
2/26/2017 4:45	13.1	45	5	W
2/26/2017 5:00	13.3	42	5	W
2/26/2017 5:15	13.6	40	5	WSW
2/26/2017 5:30	13.4	42	4	WSW
2/26/2017 5:45	12.9	43	3	WSW
2/26/2017 6:00	12.9	42	3	WSW
2/26/2017 6:15	12.8	43	4	W
2/26/2017 6:30	12.4	46	3	WSW
2/26/2017 6:45	12.6	45	4	W
2/26/2017 7:00	13	45	4	W
2/26/2017 7:15	13.2	44	4	WSW
2/26/2017 7:30	13.6	44	3	W
2/26/2017 7:45	14.1	44	3	W
2/26/2017 8:00	14.7	42	3	WSW
2/26/2017 8:15	15.4	41	3	WSW
2/26/2017 8:30	16.1	39	3	W
2/26/2017 8:45	16.8	39	3	W
2/26/2017 9:00	18	36	2	W
2/26/2017 9:15	19.3	32	4	WSW
2/26/2017 9:30	20.1	31	4	W
2/26/2017 9:45	20.5	30	3	W
2/26/2017 10:00	20.9	29	4	W
2/26/2017 10:15	21.4	29	4	W
2/26/2017 10:30	22	29	4	W
2/26/2017 10:45	22.3	28	4	WSW
2/26/2017 11:00	22.6	30	3	W
2/26/2017 11:15	22.7	29	4	W
2/26/2017 11:30	23.2	28	4	W
2/26/2017 11:45	23.9	27	5	W
2/26/2017 12:00	24.6	27	4	W
2/26/2017 12:15	25	29	5	W
2/26/2017 12:30	25.9	26	4	W
2/26/2017 12:45	26.3	29	4	W
2/26/2017 13:00	27.1	29	3	WSW
2/26/2017 13:15	27.4	30	3	W

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/26/2017 13:30	27	28	4	W
2/26/2017 13:45	27.4	33	3	W
2/26/2017 14:00	27.5	30	2	W
2/26/2017 14:15	27.5	30	3	W
2/26/2017 14:30	27.6	31	3	W
2/26/2017 14:45	27.9	30	2	WSW
2/26/2017 15:00	27.8	32	2	WSW
2/26/2017 15:15	27.3	32	3	W
2/26/2017 15:30	26.9	29	3	W
2/26/2017 15:45	27	30	2	W
2/26/2017 16:00	27.1	31	2	WSW
2/26/2017 16:15	27.4	31	2	W
2/26/2017 16:30	27.4	31	2	WSW
2/26/2017 16:45	27.5	32	1	WSW
2/26/2017 17:00	25.7	33	1	W
2/26/2017 17:15	24.7	34	1	WSW
2/26/2017 17:30	24.1	35	1	WSW
2/26/2017 17:45	23.3	37	1	WSW
2/26/2017 18:00	22.7	37	1	W
2/26/2017 18:15	22.4	38	1	W
2/26/2017 18:30	21.9	39	1	WSW
2/26/2017 18:45	21.1	40	0	WSW
2/26/2017 19:00	20.7	40	0	WSW
2/26/2017 19:15	21.1	40	1	WSW
2/26/2017 19:30	20.9	40	0	WSW
2/26/2017 19:45	20.8	40	0	W
2/26/2017 20:00	20.4	39	0	WSW
2/26/2017 20:15	20.8	38	0	SW
2/26/2017 20:30	21.2	38	0	SW
2/26/2017 20:45	20.3	40	0	SSW
2/26/2017 21:00	19.8	41	0	SE
2/26/2017 21:15	19.4	41	0	SSW
2/26/2017 21:30	19.2	41	0	SSW
2/26/2017 21:45	19.4	42	0	WSW
2/26/2017 22:00	18.9	41	0	S
2/26/2017 22:15	18.2	43	0	W
2/26/2017 22:30	17.9	42	0	E
2/26/2017 22:45	17.3	44	0	E
2/26/2017 23:00	17.4	44	0	ESE
2/26/2017 23:15	17.9	43	0	SW
2/26/2017 23:30	17.9	43	0	SSE
2/26/2017 23:45	18.3	44	0	SSW
2/27/2017 0:00	17.7	45	0	SSW
2/27/2017 0:15	18.9	44	0	S
2/27/2017 0:30	17.2	47	0	ESE
2/27/2017 0:45	17.4	45	0	SSW
2/27/2017 1:00	17.5	46	0	SSE
2/27/2017 1:15	17.4	46	0	SE
2/27/2017 1:30	17.5	45	0	SSW
2/27/2017 1:45	17.1	45	0	---
2/27/2017 2:00	16.2	47	0	---
2/27/2017 2:15	15.9	49	0	SE
2/27/2017 2:30	15.9	48	0	SE
2/27/2017 2:45	15.8	48	0	---

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/27/2017 3:00	16	48	0	SE
2/27/2017 3:15	16.2	48	0	SSW
2/27/2017 3:30	16.5	47	0	SSW
2/27/2017 3:45	15.9	49	0	WSW
2/27/2017 4:00	17	49	0	E
2/27/2017 4:15	20.7	47	0	SW
2/27/2017 4:30	22.3	45	0	SW
2/27/2017 4:45	22.3	45	0	SE
2/27/2017 5:00	20.8	47	0	E
2/27/2017 5:15	20.3	49	0	SE
2/27/2017 5:30	20.3	49	0	SSW
2/27/2017 5:45	19.8	49	0	SE
2/27/2017 6:00	18.2	49	0	---
2/27/2017 6:15	17.4	51	0	SE
2/27/2017 6:30	17	50	0	SE
2/27/2017 6:45	18	47	0	SSW
2/27/2017 7:00	18.1	45	0	SE
2/27/2017 7:15	19.5	41	0	SE
2/27/2017 7:30	21.6	41	0	NNE
2/27/2017 7:45	21.2	42	0	SW
2/27/2017 8:00	22.3	42	0	---
2/27/2017 8:15	22.9	40	0	WSW
2/27/2017 8:30	25.1	40	0	N
2/27/2017 8:45	26.8	39	0	NNE
2/27/2017 9:00	29.2	36	0	E
2/27/2017 9:15	32	32	0	NNE
2/27/2017 9:30	33.4	32	1	NNE
2/27/2017 9:45	34.4	32	1	NE
2/27/2017 10:00	36.5	30	1	WSW
2/27/2017 10:15	37.2	31	2	W
2/27/2017 10:30	37.4	32	1	WNW
2/27/2017 10:45	37.7	30	1	WNW
2/27/2017 11:00	38.6	30	1	WNW
2/27/2017 11:15	38.7	30	2	WNW
2/27/2017 11:30	39.6	29	1	NW
2/27/2017 11:45	40	29	1	WNW
2/27/2017 12:00	40.6	27	1	WNW
2/27/2017 12:15	40.9	27	2	WNW
2/27/2017 12:30	40.9	29	2	WNW
2/27/2017 12:45	39.1	31	2	WNW
2/27/2017 13:00	38.4	34	2	W
2/27/2017 13:15	38.3	33	1	W
2/27/2017 13:30	38.3	34	1	WSW
2/27/2017 13:45	38.4	31	1	WNW
2/27/2017 14:00	38.9	31	1	WNW
2/27/2017 14:15	39.8	27	1	WNW
2/27/2017 14:30	41.7	28	1	W
2/27/2017 14:45	41.3	28	2	WSW
2/27/2017 15:00	40	28	2	WSW
2/27/2017 15:15	40.2	29	1	WSW
2/27/2017 15:30	39.9	29	1	WSW
2/27/2017 15:45	38.9	32	1	SW
2/27/2017 16:00	38.4	32	1	SW
2/27/2017 16:15	37.9	32	1	SW

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/27/2017 16:30	37.2	35	1	S
2/27/2017 16:45	36.5	37	1	WSW
2/27/2017 17:00	35.7	38	1	SW
2/27/2017 17:15	34.8	40	0	WNW
2/27/2017 17:30	33.7	44	0	SW
2/27/2017 17:45	32.9	44	0	SW
2/27/2017 18:00	32.7	43	0	SSW
2/27/2017 18:15	32.8	43	1	S
2/27/2017 18:30	32.3	44	0	S
2/27/2017 18:45	32.4	47	1	SSW
2/27/2017 19:00	32	50	0	SSW
2/27/2017 19:15	32.4	45	1	SSW
2/27/2017 19:30	32.4	45	1	SSW
2/27/2017 19:45	32	45	0	E
2/27/2017 20:00	31.4	45	0	SSW
2/27/2017 20:15	30.9	47	0	SSW
2/27/2017 20:30	30	51	0	SSE
2/27/2017 20:45	29.8	50	0	SSW
2/27/2017 21:00	30	52	0	---
2/27/2017 21:15	30.3	48	0	WNW
2/27/2017 21:30	30.4	49	0	---
2/27/2017 21:45	31.4	48	1	SSW
2/27/2017 22:00	30.7	52	0	SSW
2/27/2017 22:15	30.5	54	0	S
2/27/2017 22:30	30.2	52	0	---
2/27/2017 22:45	30.1	56	0	ENE
2/27/2017 23:00	29.8	59	0	SSW
2/27/2017 23:15	29.3	63	0	SSW
2/27/2017 23:30	28.6	67	0	SSW
2/27/2017 23:45	28.7	66	0	SW
2/28/2017 0:00	25.5	74	0	ENE
2/28/2017 0:15	24.9	75	0	NNW
2/28/2017 0:30	24.1	76	0	NW
2/28/2017 0:45	23.7	77	0	ENE
2/28/2017 1:00	23.4	78	0	---
2/28/2017 1:15	22.9	79	0	---
2/28/2017 1:30	22.8	80	0	---
2/28/2017 1:45	22.5	81	0	---
2/28/2017 2:00	22.1	82	0	ENE
2/28/2017 2:15	21.2	84	0	---
2/28/2017 2:30	20.8	84	0	---
2/28/2017 2:45	20.1	85	0	---
2/28/2017 3:00	19.7	88	0	---
2/28/2017 3:15	19.7	87	0	ENE
2/28/2017 3:30	20	87	0	---
2/28/2017 3:45	20.3	87	0	---
2/28/2017 4:00	20.7	86	0	---
2/28/2017 4:15	20.7	85	0	---
2/28/2017 4:30	20.5	86	0	---
2/28/2017 4:45	20.5	86	0	ENE
2/28/2017 5:00	20.6	86	0	ENE
2/28/2017 5:15	20.6	86	0	---
2/28/2017 5:30	20.6	85	0	E
2/28/2017 5:45	20.2	87	0	ENE

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/28/2017 6:00	20.1	87	0	NNE
2/28/2017 6:15	20.2	87	0	---
2/28/2017 6:30	20.3	87	0	---
2/28/2017 6:45	20.4	86	0	---
2/28/2017 7:00	20.5	86	0	---
2/28/2017 7:15	20.7	86	0	---
2/28/2017 7:30	21.3	86	0	---
2/28/2017 7:45	22.2	84	0	---
2/28/2017 8:00	23.1	72	0	E
2/28/2017 8:15	23.8	69	0	E
2/28/2017 8:30	24.7	67	0	NE
2/28/2017 8:45	25.1	66	0	ENE
2/28/2017 9:00	25.5	69	0	NNE
2/28/2017 9:15	26.2	66	0	NNE
2/28/2017 9:30	26.2	66	1	NNE
2/28/2017 9:45	27.7	62	1	NNE
2/28/2017 10:00	27.7	59	1	NNE
2/28/2017 10:15	27.9	61	1	NNE
2/28/2017 10:30	27.9	66	2	NNE
2/28/2017 10:45	28.5	60	1	NNE
2/28/2017 11:00	29.2	60	1	NW
2/28/2017 11:15	29.4	55	1	NNE
2/28/2017 11:30	29.1	58	1	NNE
2/28/2017 11:45	30.2	55	1	NNE
2/28/2017 12:00	29.1	57	1	NNE
2/28/2017 12:15	29.3	57	2	NNE
2/28/2017 12:30	29.4	57	2	NNE
2/28/2017 12:45	28.6	58	2	NNE
2/28/2017 13:00	28.6	60	1	NNE
2/28/2017 13:15	27.9	60	1	NE
2/28/2017 13:30	28.1	60	1	NNE
2/28/2017 13:45	28	61	1	NNE
2/28/2017 14:00	29.2	49	1	NNE
2/28/2017 14:15	30	47	3	WNW
2/28/2017 14:30	28.5	50	2	WSW
2/28/2017 14:45	27.1	53	2	W
2/28/2017 15:00	28.9	49	2	W
2/28/2017 15:15	28.5	49	2	WSW
2/28/2017 15:30	28	48	2	WSW
2/28/2017 15:45	27.7	50	2	WSW
2/28/2017 16:00	25.5	53	2	W
2/28/2017 16:15	24.1	55	2	W
2/28/2017 16:30	23.3	53	2	WSW
2/28/2017 16:45	22.3	53	2	W
2/28/2017 17:00	20	54	2	W
2/28/2017 17:15	19.1	49	3	W
2/28/2017 17:30	18.5	48	3	W
2/28/2017 17:45	17.8	50	3	W
2/28/2017 18:00	17.4	50	3	WSW
2/28/2017 18:15	16.8	47	3	WSW
2/28/2017 18:30	16.5	48	4	W
2/28/2017 18:45	15.9	51	4	W
2/28/2017 19:00	15.6	53	3	WSW
2/28/2017 19:15	15.6	53	4	W

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
2/28/2017 19:30	15.5	53	2	W
2/28/2017 19:45	15.5	54	2	W
2/28/2017 20:00	15.4	53	2	WSW
2/28/2017 20:15	15.2	54	3	WSW
2/28/2017 20:30	15.1	52	3	W
2/28/2017 20:45	14.9	52	3	W
2/28/2017 21:00	15	55	4	W
2/28/2017 21:15	14.9	56	3	W
2/28/2017 21:30	15	57	5	W
2/28/2017 21:45	15.2	55	4	W
2/28/2017 22:00	14.9	56	4	WNW
2/28/2017 22:15	15.4	50	4	W
2/28/2017 22:30	15.2	51	4	WNW
2/28/2017 22:45	15	52	3	SW
2/28/2017 23:00	15	52	4	WSW
2/28/2017 23:15	15.2	53	6	W
2/28/2017 23:30	15.5	52	7	WNW
2/28/2017 23:45	16	49	9	WSW
3/1/2017 0:00	16.3	47	9	W
3/1/2017 0:15	16.2	50	10	W
3/1/2017 0:30	16.2	50	8	W
3/1/2017 0:45	16.5	47	10	WSW
3/1/2017 1:00	16.1	55	11	W
3/1/2017 1:15	15.3	63	10	W
3/1/2017 1:30	14.5	69	9	WSW
3/1/2017 1:45	15.5	59	6	W
3/1/2017 2:00	15.8	54	6	WNW
3/1/2017 2:15	15.5	54	3	WNW
3/1/2017 2:30	15	56	3	W
3/1/2017 2:45	15	55	7	W
3/1/2017 3:00	15	56	6	W
3/1/2017 3:15	15	54	8	WNW
3/1/2017 3:30	15	51	8	WNW
3/1/2017 3:45	15.1	48	10	W
3/1/2017 4:00	14.7	56	9	W
3/1/2017 4:15	14	64	10	W
3/1/2017 4:30	14.7	53	10	W
3/1/2017 4:45	14.6	55	11	W
3/1/2017 5:00	14.6	51	10	W
3/1/2017 5:15	14.7	48	11	W
3/1/2017 5:30	14.8	48	10	WSW
3/1/2017 5:45	14.9	47	12	W
3/1/2017 6:00	14.8	49	11	W
3/1/2017 6:15	14.7	48	10	W
3/1/2017 6:30	14.7	47	11	WSW
3/1/2017 6:45	14.7	47	9	W
3/1/2017 7:00	14.8	47	9	WSW
3/1/2017 7:15	15	46	8	W
3/1/2017 7:30	15.4	46	8	WSW
3/1/2017 7:45	15.7	46	7	W
3/1/2017 8:00	16.1	45	6	WNW
3/1/2017 8:15	16.3	46	5	W
3/1/2017 8:30	16.7	46	6	W
3/1/2017 8:45	17	44	8	W

Date/Time	Temperature (Degrees F)	Humidity (%)	Wind Speed (mph)	Wind Direction
3/1/2017 9:00	17.8	43	7	W
3/1/2017 9:15	19.2	40	6	W
3/1/2017 9:30	20.4	39	4	W
3/1/2017 9:45	21.1	40	3	WSW
3/1/2017 10:00	21.5	38	3	WSW
3/1/2017 10:15	21.7	38	4	W
3/1/2017 10:30	22.4	36	4	WSW
3/1/2017 10:45	23.7	38	3	W
3/1/2017 11:00	24.5	35	3	W
3/1/2017 11:15	25.2	36	3	WSW
3/1/2017 11:30	25.4	33	4	W
3/1/2017 11:45	26.6	34	4	W
3/1/2017 12:00	27.3	32	3	WSW
3/1/2017 12:15	27.5	33	4	W
3/1/2017 12:30	28.7	31	3	WSW
3/1/2017 12:45	29.6	30	3	W
3/1/2017 13:00	29.3	29	4	W
3/1/2017 13:15	29.2	30	3	W
3/1/2017 13:30	28.7	30	4	WSW
3/1/2017 13:45	28.3	30	3	WSW
3/1/2017 14:00	27.8	32	4	WSW
3/1/2017 14:15	29	33	5	W
3/1/2017 14:30	30.1	33	6	W
3/1/2017 14:45	29.9	35	6	W
3/1/2017 15:00	28.5	36	7	W

Appendix D - Tabulated Ambient Sound Level Data

Date/Time	Location 1	Location 2	Location 3
2/22/2017 14:00	41.2	-	-
2/22/2017 15:00	39.3	40.1	56.5
2/22/2017 16:00	35.1	36.4	56.9
2/22/2017 17:00	42.1	41.6	58.2
2/22/2017 18:00	37.5	35	56.8
2/22/2017 19:00	38.4	37.3	55.2
2/22/2017 20:00	37.6	35.8	53
2/22/2017 21:00	36.9	36.9	51.9
2/22/2017 22:00	39.1	36.9	51
2/22/2017 23:00	22.3	22.3	46.9
2/23/2017 0:00	20.5	17.4	43.5
2/23/2017 1:00	29.3	23.8	41.7
2/23/2017 2:00	30.3	32.2	40.3
2/23/2017 3:00	22.4	21.4	42.7
2/23/2017 4:00	28.5	30.2	45.1
2/23/2017 5:00	21.8	28.9	49.4
2/23/2017 6:00	27.8	25.1	54.3
2/23/2017 7:00	36	31.1	52.9
2/23/2017 8:00	39.9	37.6	50.9
2/23/2017 9:00	36.6	34	49.9
2/23/2017 10:00	34	36.2	50
2/23/2017 11:00	31.7	30.2	52.7
2/23/2017 12:00	35.6	32.6	54.9
2/23/2017 13:00	37.6	33.7	52.5
2/23/2017 14:00	36.1	32.4	52.9
2/23/2017 15:00	39.7	33.8	66.8
2/23/2017 16:00	34.4	33.2	53.7
2/23/2017 17:00	33.6	30.7	54.4
2/23/2017 18:00	32.4	29.9	52.4
2/23/2017 19:00	33.6	31.5	52.3
2/23/2017 20:00	36.7	33.8	47
2/23/2017 21:00	23.9	26.2	45.5
2/23/2017 22:00	38.7	35.1	49.4
2/23/2017 23:00	30.5	31.1	44.6
2/24/2017 0:00	22	21.5	43.2
2/24/2017 1:00	15.4	14.2	36.3
2/24/2017 2:00	15.6	13.5	39.8
2/24/2017 3:00	12.8	13.3	45.7
2/24/2017 4:00	19.2	23.1	51.5
2/24/2017 5:00	31	26	44.5
2/24/2017 6:00	27.5	25	46.5
2/24/2017 7:00	33.2	30.1	46
2/24/2017 8:00	32	28	48.4
2/24/2017 9:00	36.4	32.9	48.7
2/24/2017 10:00	35.9	34.5	51.4
2/24/2017 11:00	36.2	32.6	51.6
2/24/2017 12:00	38.3	35	52.1
2/24/2017 13:00	38.4	34.4	53.8
2/24/2017 14:00	33.8	32.1	54.2

Date/Time	Location 1	Location 2	Location 3
2/24/2017 15:00	30.7	31.6	48.6
2/24/2017 16:00	34.9	30.9	49.6
2/24/2017 17:00	32.9	31.9	52.2
2/24/2017 18:00	35.7	32.9	49.9
2/24/2017 19:00	34.7	33.3	48.5
2/24/2017 20:00	30.6	27.8	48.1
2/24/2017 21:00	34.6	38.9	45.8
2/24/2017 22:00	35.3	35.4	46.4
2/24/2017 23:00	32.3	32	43.7
2/25/2017 0:00	50.8	50.3	47.2
2/25/2017 1:00	55.2	52.8	49.6
2/25/2017 2:00	53.9	54.5	52.2
2/25/2017 3:00	53.8	54.2	50.2
2/25/2017 4:00	52.3	52.2	51.5
2/25/2017 5:00	59	57.5	53.4
2/25/2017 6:00	57.2	52.2	50.7
2/25/2017 7:00	38.2	40.4	50.4
2/25/2017 8:00	39.5	42.9	55.1
2/25/2017 9:00	44.1	47.2	54.5
2/25/2017 10:00	51.3	45	53.6
2/25/2017 11:00	50.6	49.2	54.2
2/25/2017 12:00	48.6	52	54.4
2/25/2017 13:00	58.1	60.1	58.1
2/25/2017 14:00	69.3	62.3	60.3
2/25/2017 15:00	63	54.5	55.6
2/25/2017 16:00	40.9	34.8	54.4
2/25/2017 17:00	40.1	29.4	54
2/25/2017 18:00	32.1	29.9	51.5
2/25/2017 19:00	38.7	35.8	50.5
2/25/2017 20:00	46.4	46.7	51.1
2/25/2017 21:00	53.4	45.2	51.6
2/25/2017 22:00	52.5	54	53.4
2/25/2017 23:00	44.5	48.5	48.7
2/26/2017 0:00	43.9	53.4	53.5
2/26/2017 1:00	46.1	54.4	48.1
2/26/2017 2:00	42.5	57.8	50.5
2/26/2017 3:00	36.3	54.1	49.5
2/26/2017 4:00	44.2	55.3	50
2/26/2017 5:00	41.1	57.9	46.3
2/26/2017 6:00	48.1	60.1	55.6
2/26/2017 7:00	54.3	57.2	55.4
2/26/2017 8:00	56	57.2	56.2
2/26/2017 9:00	51.3	57.9	56.3
2/26/2017 10:00	54.6	57.7	58.4
2/26/2017 11:00	58.9	60.1	55.5
2/26/2017 12:00	59.3	55.3	56.4
2/26/2017 13:00	58.9	51.3	56.8
2/26/2017 14:00	54.5	50	54.9
2/26/2017 15:00	51.1	48.9	54.6

Date/Time	Location 1	Location 2	Location 3
2/26/2017 16:00	49.8	45.4	53.6
2/26/2017 17:00	51.6	42.9	53.5
2/26/2017 18:00	51.4	42	52.1
2/26/2017 19:00	46.3	38.9	49.6
2/26/2017 20:00	39	32.8	49.5
2/26/2017 21:00	27.5	29.2	48.4
2/26/2017 22:00	32.9	31.8	48.4
2/26/2017 23:00	29.3	31.9	44
2/27/2017 0:00	37.9	22.6	37.7
2/27/2017 1:00	35.1	25.9	40
2/27/2017 2:00	19.6	18	33.9
2/27/2017 3:00	18.5	18	38.6
2/27/2017 4:00	24.1	28.2	45
2/27/2017 5:00	29.1	26	50
2/27/2017 6:00	29.3	28.4	54.9
2/27/2017 7:00	32.8	52.9	54.9
2/27/2017 8:00	34.5	32.6	55
2/27/2017 9:00	36	34	53
2/27/2017 10:00	59.6	45.5	52.8
2/27/2017 11:00	44.1	37.9	53.3
2/27/2017 12:00	45	39.7	53.4
2/27/2017 13:00	40.8	33.5	54.4
2/27/2017 14:00	50.7	39.9	55.4
2/27/2017 15:00	48	36.4	57.3
2/27/2017 16:00	45.9	36.4	56.9
2/27/2017 17:00	40	36.5	57.7
2/27/2017 18:00	35.1	34.3	57.8
2/27/2017 19:00	42.2	36.2	54.9
2/27/2017 20:00	37.2	32	52.3
2/27/2017 21:00	34.1	30.6	50.7
2/27/2017 22:00	37.9	33.7	47.2
2/27/2017 23:00	22.2	21	47.1
2/28/2017 0:00	19.7	14.4	42.9
2/28/2017 1:00	39.4	32.3	42
2/28/2017 2:00	24.9	21.8	38
2/28/2017 3:00	13.3	21.7	42
2/28/2017 4:00	29.6	26.8	47.4
2/28/2017 5:00	22.8	17.5	51.7
2/28/2017 6:00	31.6	28.8	55.4
2/28/2017 7:00	34.3	34.7	56.6
2/28/2017 8:00	38.6	36.3	56
2/28/2017 9:00	37	34.4	54.7
2/28/2017 10:00	37.2	37.3	55
2/28/2017 11:00	35.3	37	54.3
2/28/2017 12:00	34.2	34.4	54.2
2/28/2017 13:00	38.4	39.6	54
2/28/2017 14:00	48.8	49.1	55.6
2/28/2017 15:00	51.4	50.3	56.4
2/28/2017 16:00	50	52.2	57.3

Date/Time	Location 1	Location 2	Location 3
2/28/2017 17:00	52	53.7	57.8
2/28/2017 18:00	48.9	53.4	57.4
2/28/2017 19:00	44.3	50.7	54.1
2/28/2017 20:00	55.4	56.9	54.1
2/28/2017 21:00	50.9	56.4	54.3
2/28/2017 22:00	46.8	53.9	52.7
2/28/2017 23:00	60.1	64.2	58.4
3/1/2017 0:00	67.4	67.6	63.4
3/1/2017 1:00	64.3	65.6	64.7
3/1/2017 2:00	53.6	58.3	61.7
3/1/2017 3:00	57.3	65.5	60.4
3/1/2017 4:00	56	67.5	68
3/1/2017 5:00	63	70.6	67
3/1/2017 6:00	61.4	70	64.7
3/1/2017 7:00	57	64.2	62.3
3/1/2017 8:00	58.7	65.8	59.1
3/1/2017 9:00	51	59.7	56
3/1/2017 10:00	53.9	56.1	57.7
3/1/2017 11:00	56.3	52.9	57.1
3/1/2017 12:00	52.2	53.9	58.1
3/1/2017 13:00	54.1	54.4	55.1
3/1/2017 14:00	68.7	64.1	60.9
3/1/2017 15:00	-	-	61.1

Appendix E - Ambient Sound Level Averages

Average Ambient Sound Levels for the Daytime Period (dBA)

Date	Location 1	Location 2	Location 3
February 22	-	-	-
February 23	36.3	33.5	57.6
February 24	35.1	32.3	51.0
February 25	46.8	44.0	53.8
February 26	51.6	42.9	53.5
February 27	50.6	44.2	55.2
February 28	40.9	41.0	55.2
March 1	-	-	-
Average Ambient Sound Level	**47.4**	**41.6**	**54.8**

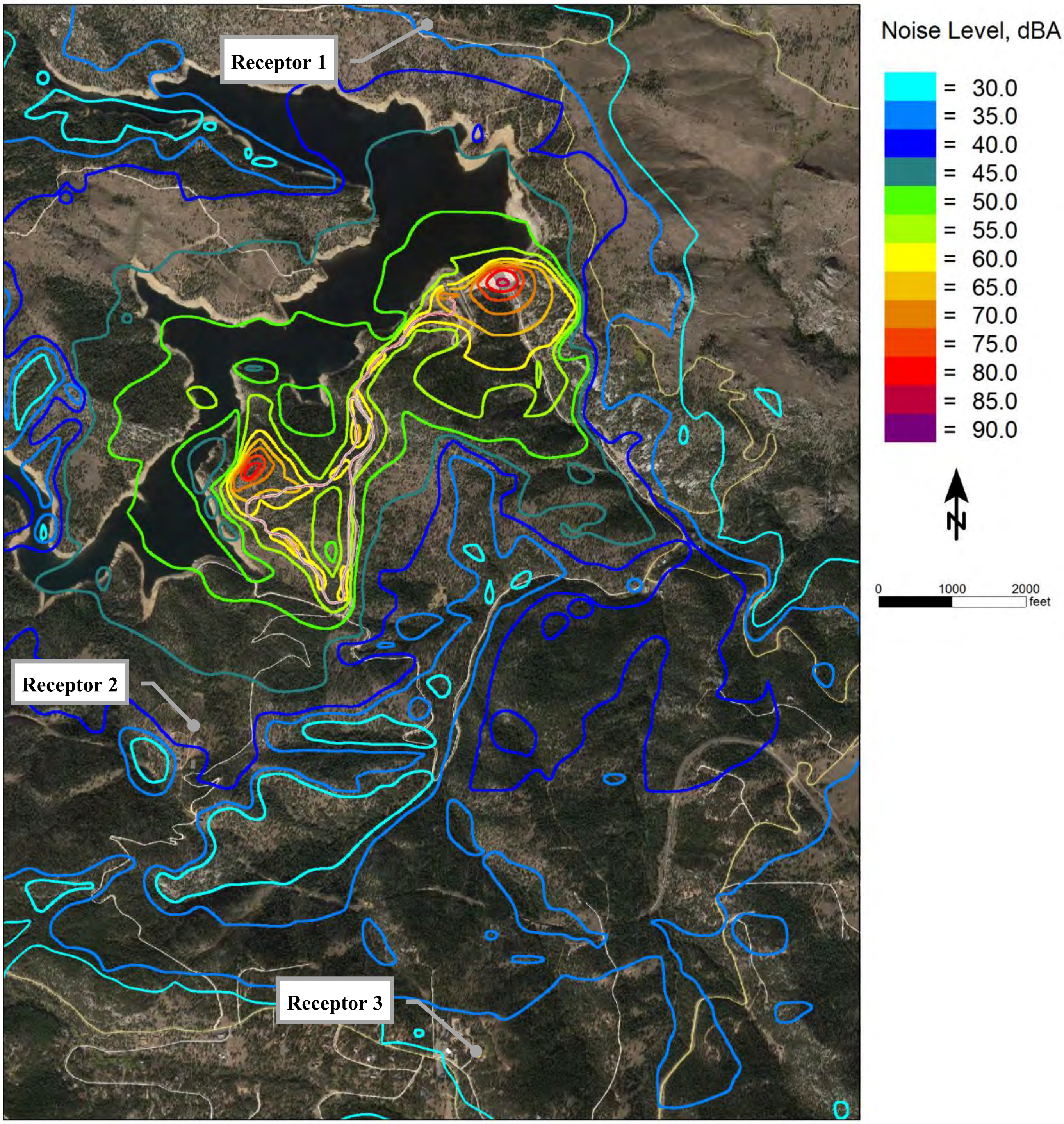
Average Ambient Sound Levels for the Evening Period (dBA)

Date	Location 1	Location 2	Location 3
February 22	37.2	35.7	53.5
February 23	34.6	32.1	49.6
February 24	34.2	34.7	47.5
February 25	42.4	42.4	51.1
February 26	45.1	36.9	49.3
February 27	37.5	33.0	53.4
February 28	-	-	-
March 1	-	-	-
Average Ambient Sound Level	**40.4**	**37.3**	**51.2**

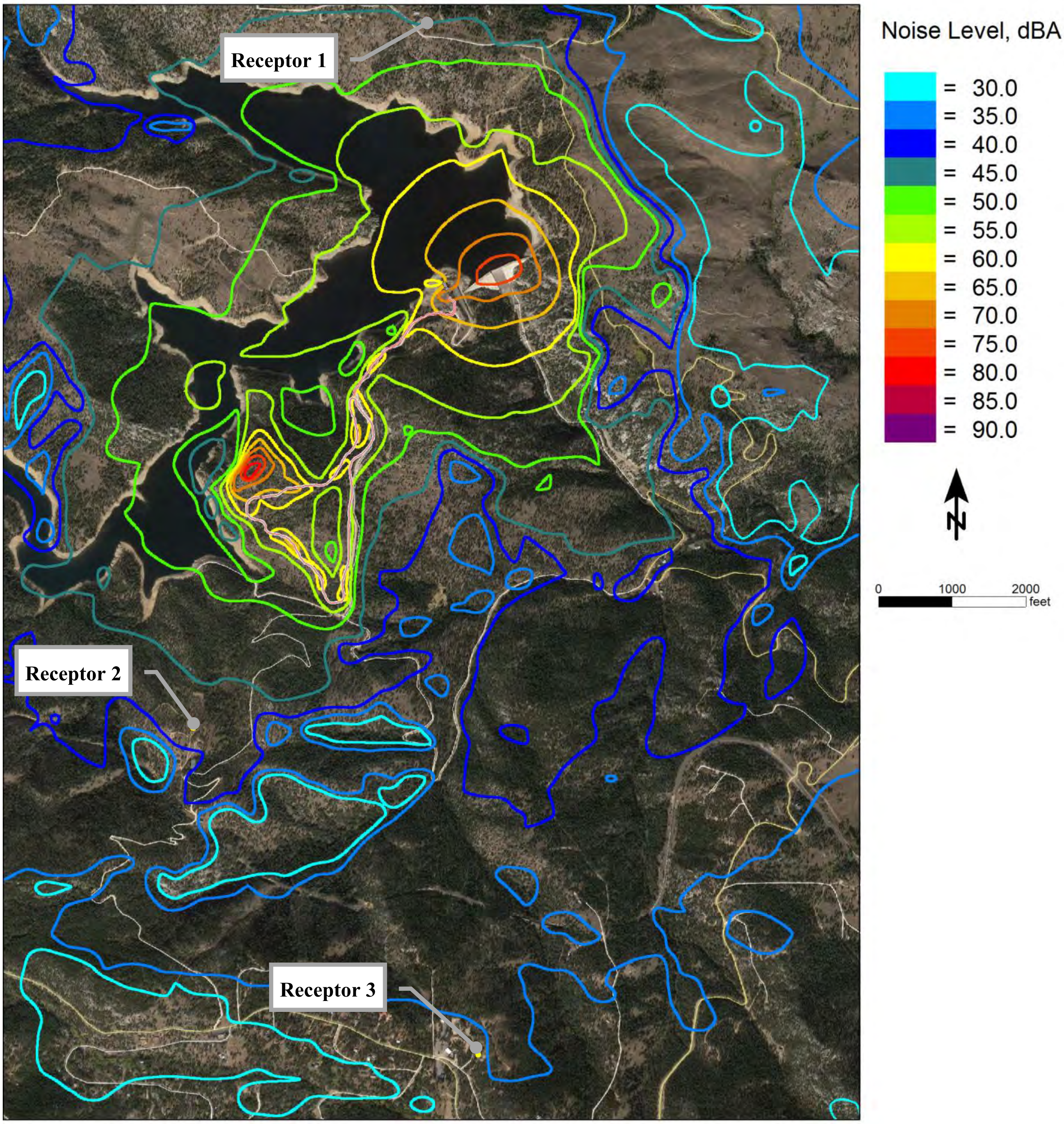
Average Ambient Sound Levels for the Nighttime Period (dBA)

Date	Location 1	Location 2	Location 3
February 22	-	-	-
February 23	27.1	28.1	44.9
February 24	24.2	21.3	46.0
February 25	-	-	-
February 26	-	-	-
February 27	32.5	24.7	44.2
February 28	32.3	26.3	46.4
March 1	-	-	-
Average Ambient Sound Level	**30.3**	**25.8**	**45.5**

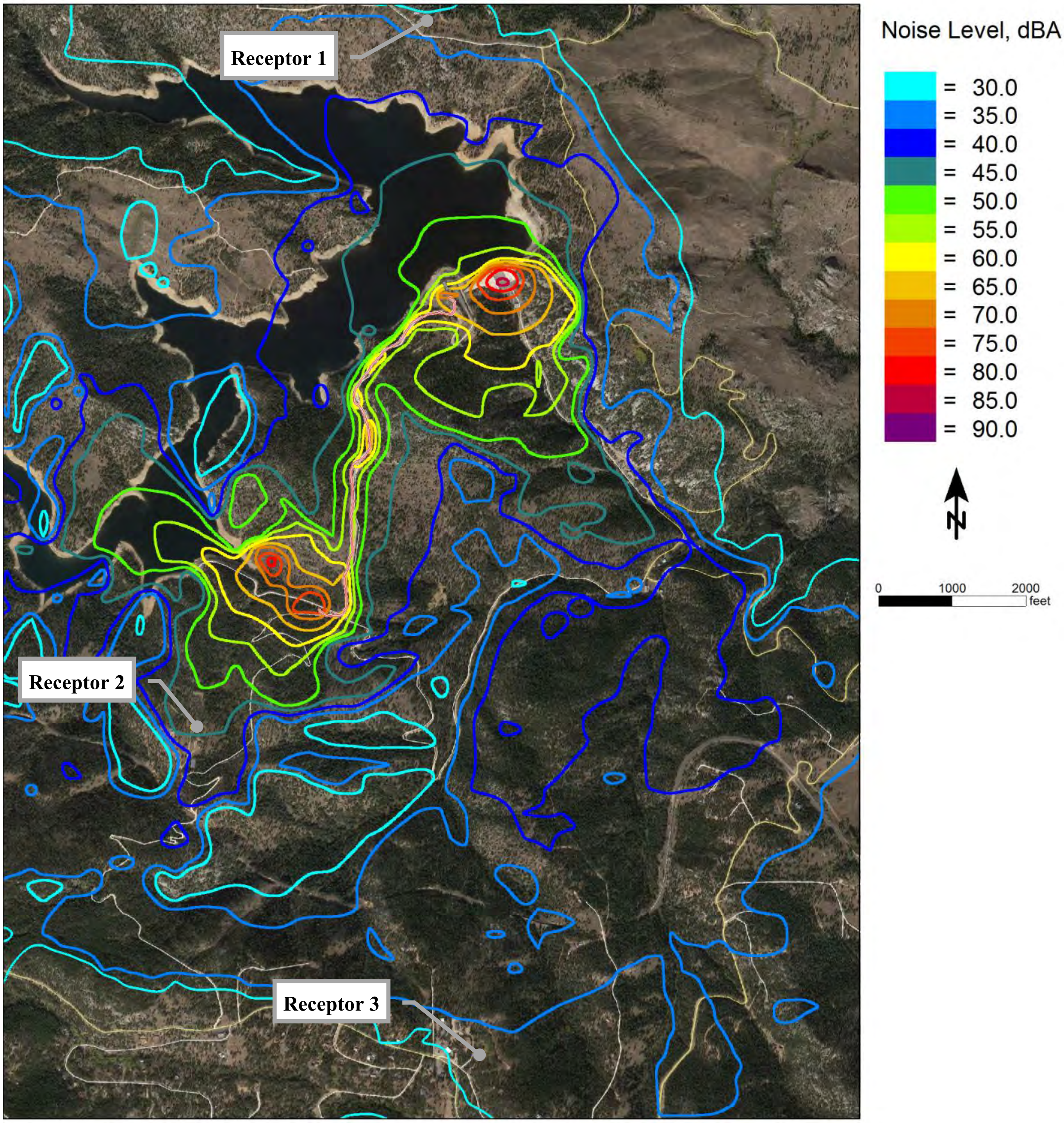
Appendix F - Noise Contour Maps



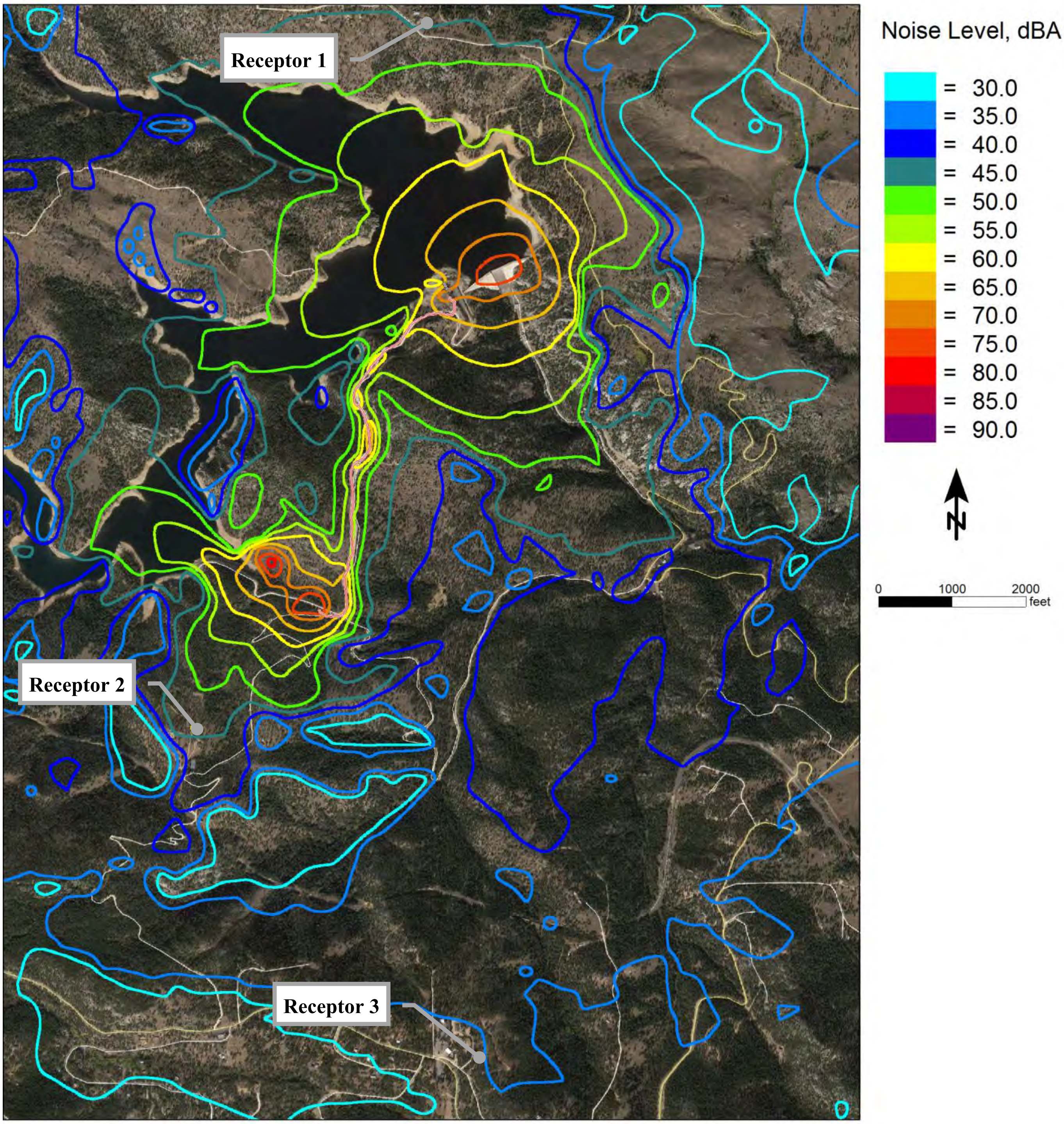
Noise Contour Map of Scenario 1- FEIS Quarry Daytime with Haul Trucks Years 1-2 (dBA)



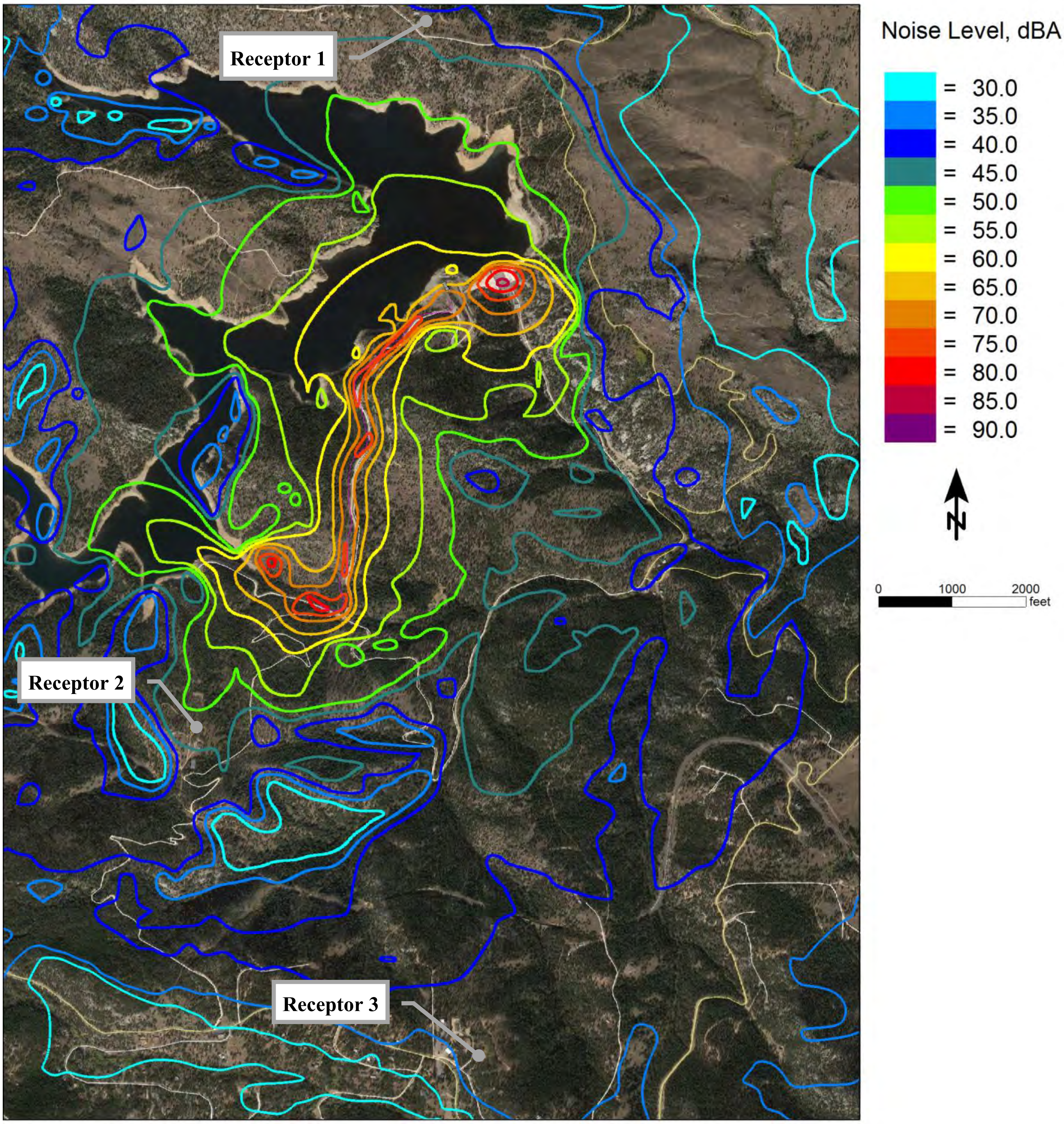
Noise Contour Map of Scenario 1- FEIS Quarry Daytime with Haul Trucks Year 3 (dBA)



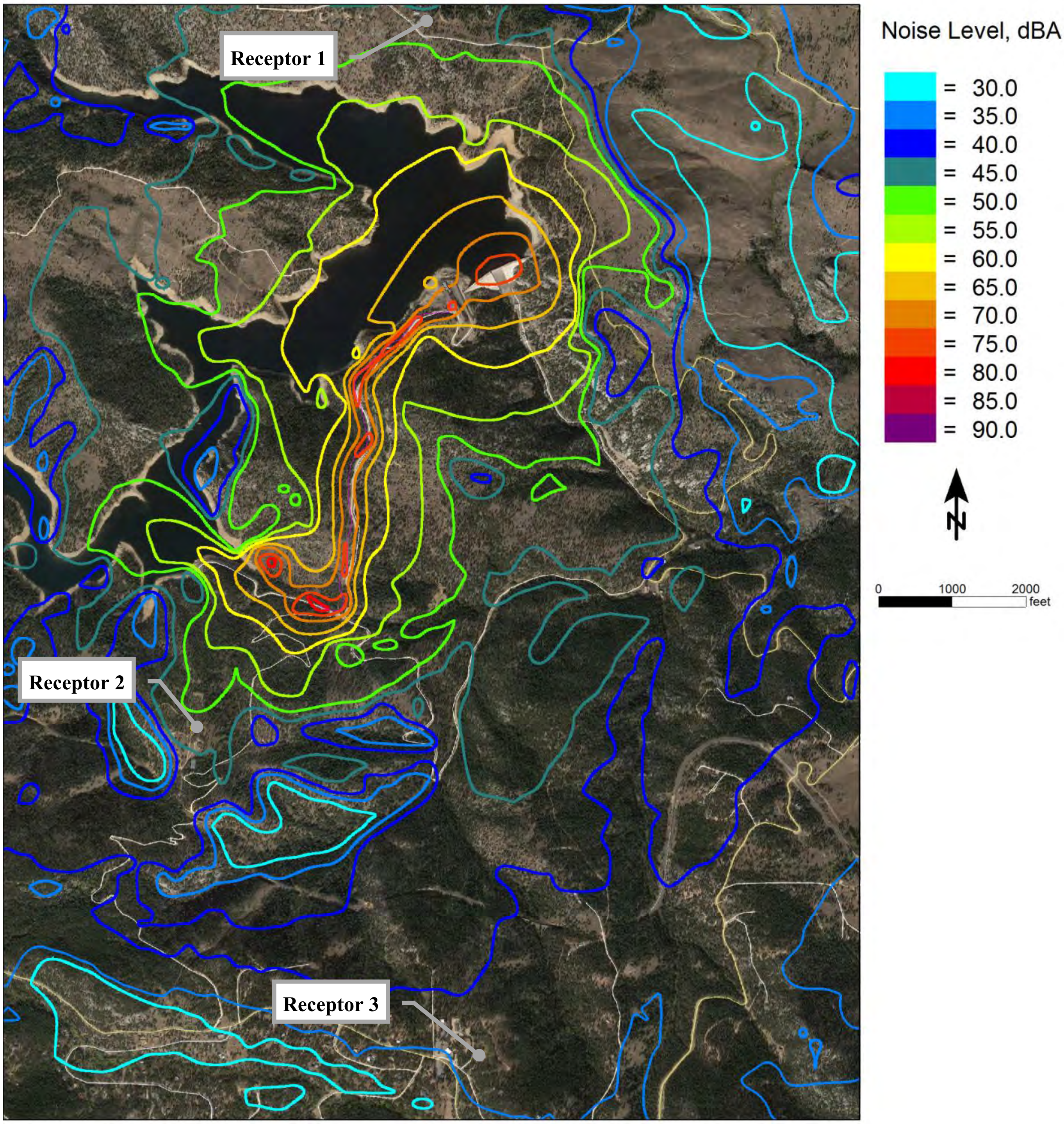
Noise Contour Map of Scenario 2- Osprey Quarry Daytime with Haul Trucks Years 1-2 (dBA)



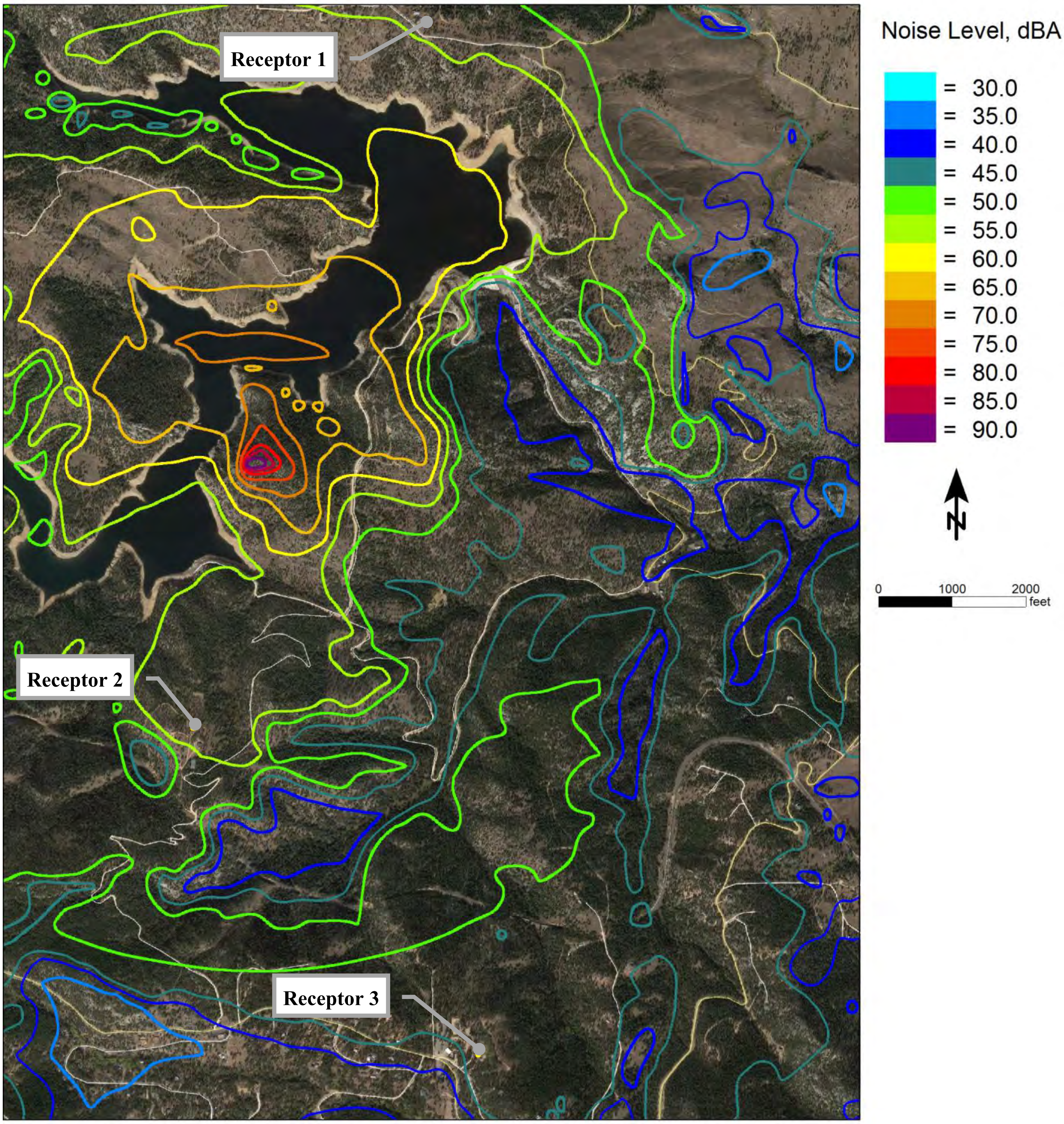
Noise Contour Map of Scenario 2- Osprey Quarry Daytime with Haul Trucks Year 3 (dBA)



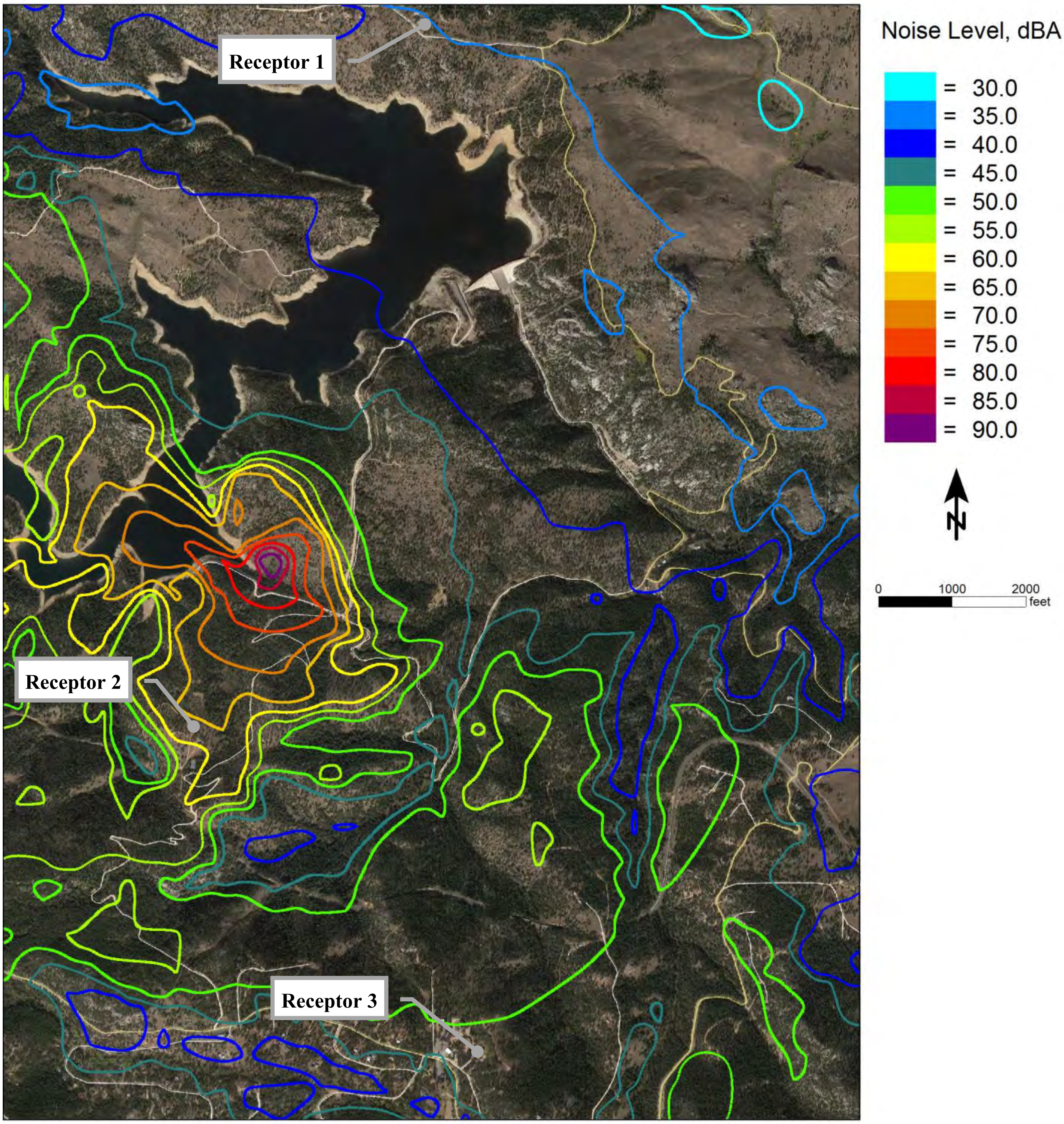
Noise Contour Map of Scenario 3- Osprey Quarry Daytime with Conveyor using Steel Idler Rollers Years 1-2 (dBA)



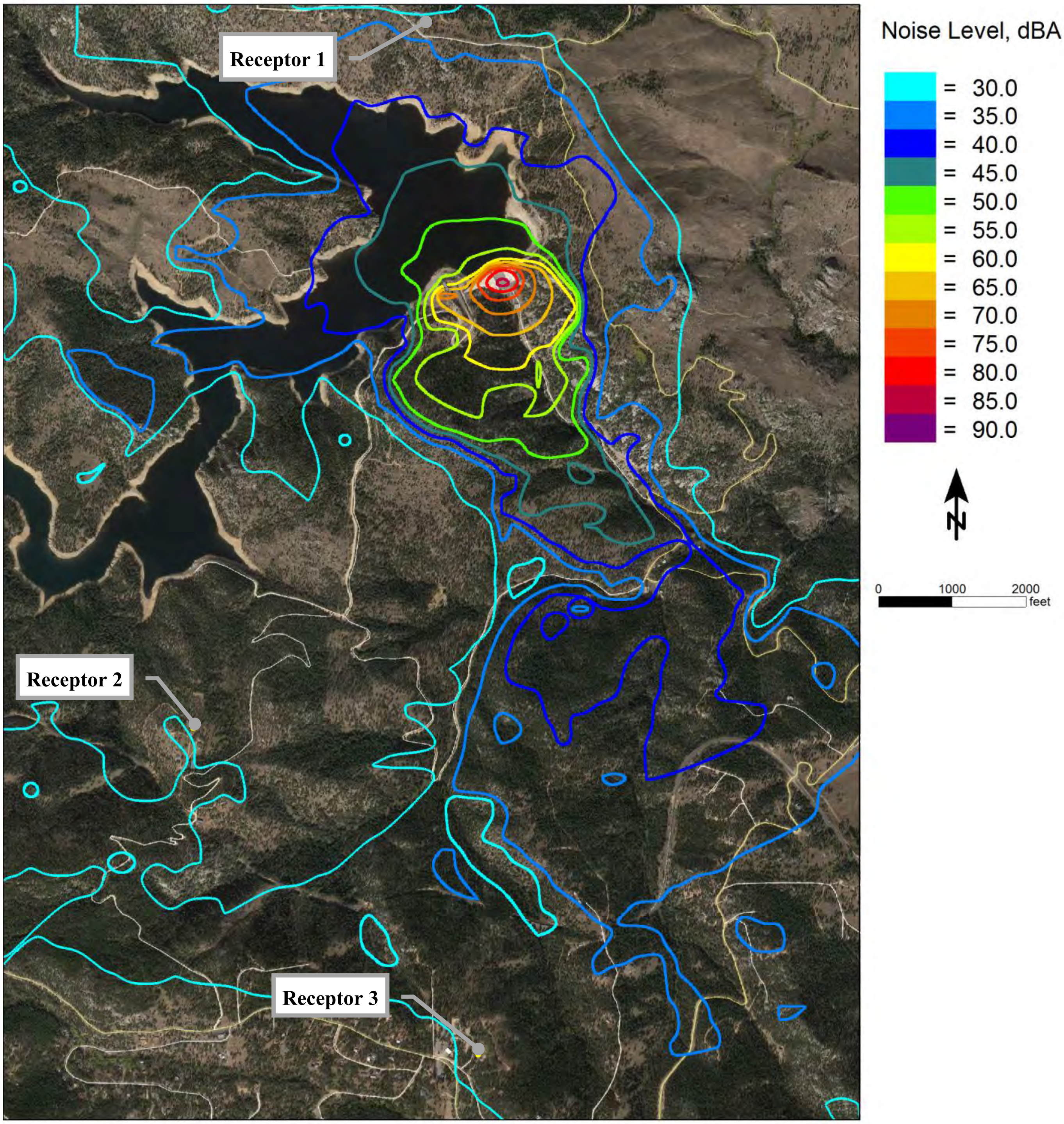
Noise Contour Map of Scenario 3- Osprey Quarry Daytime with Conveyor using Steel Idler Rollers Year 3 (dBA)



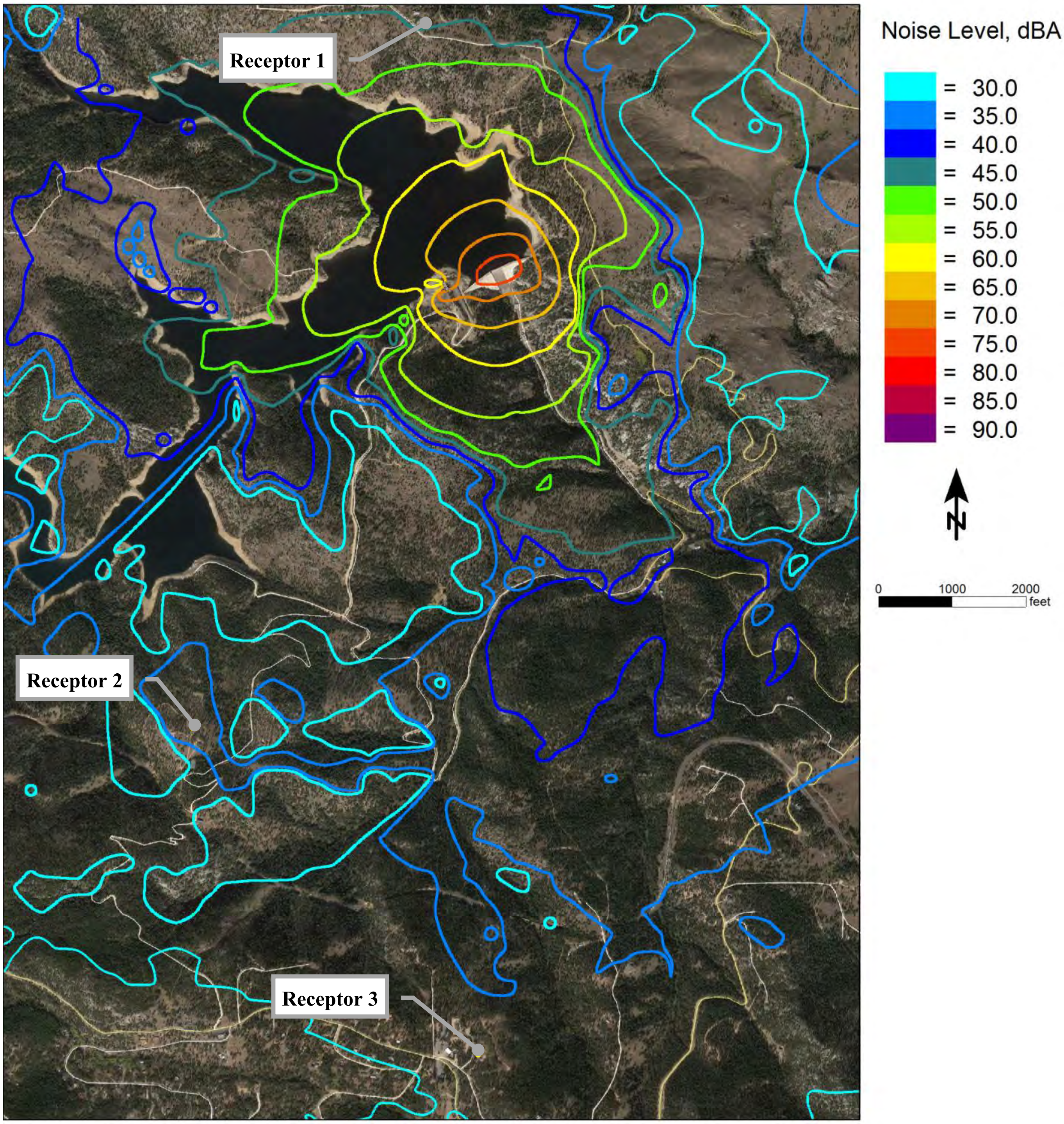
Noise Contour Map of Scenario 4- FEIS Daytime Blasting (dBA)



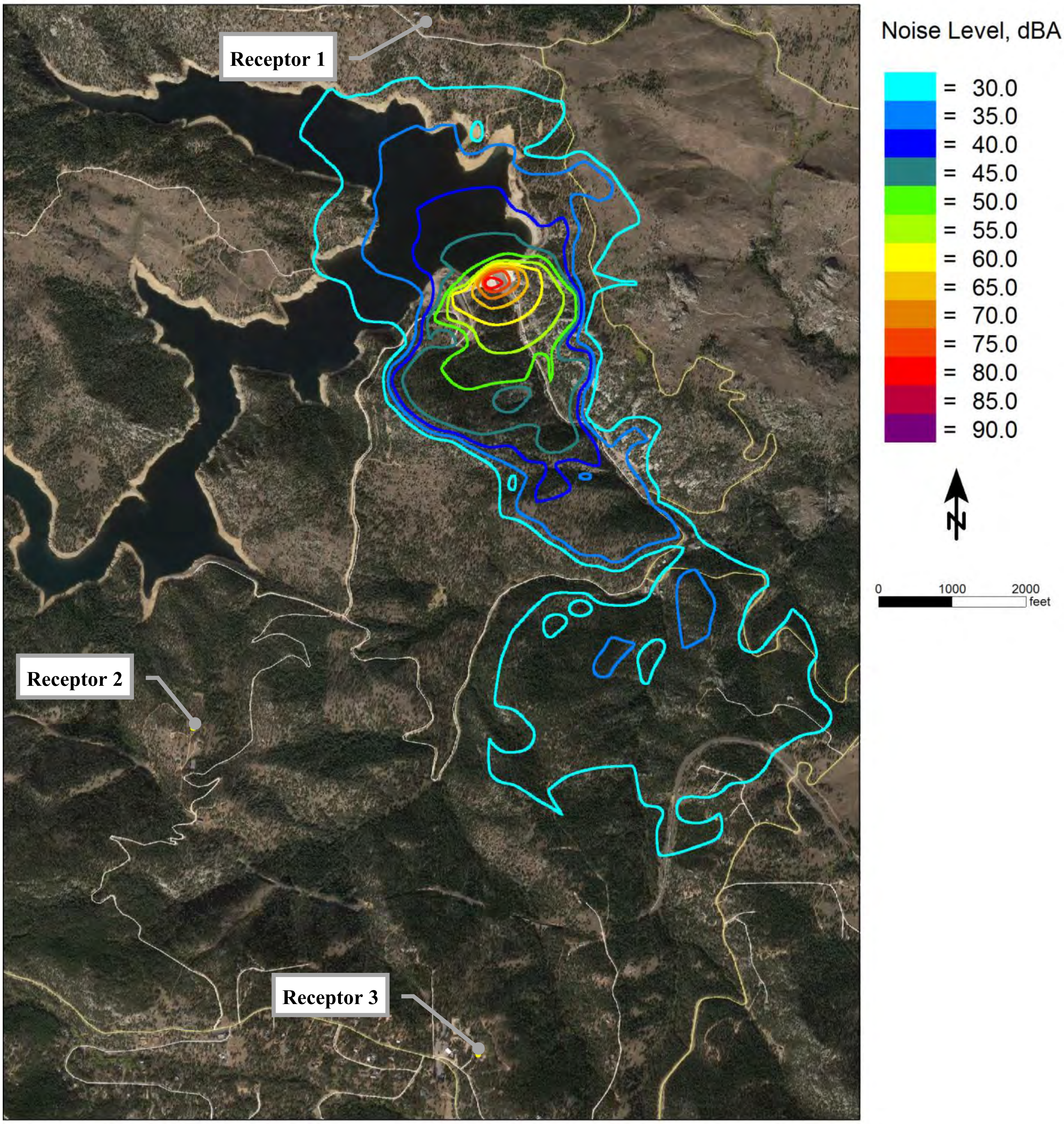
Noise Contour Map of Scenario 5- Osprey Daytime Blasting (dBA)



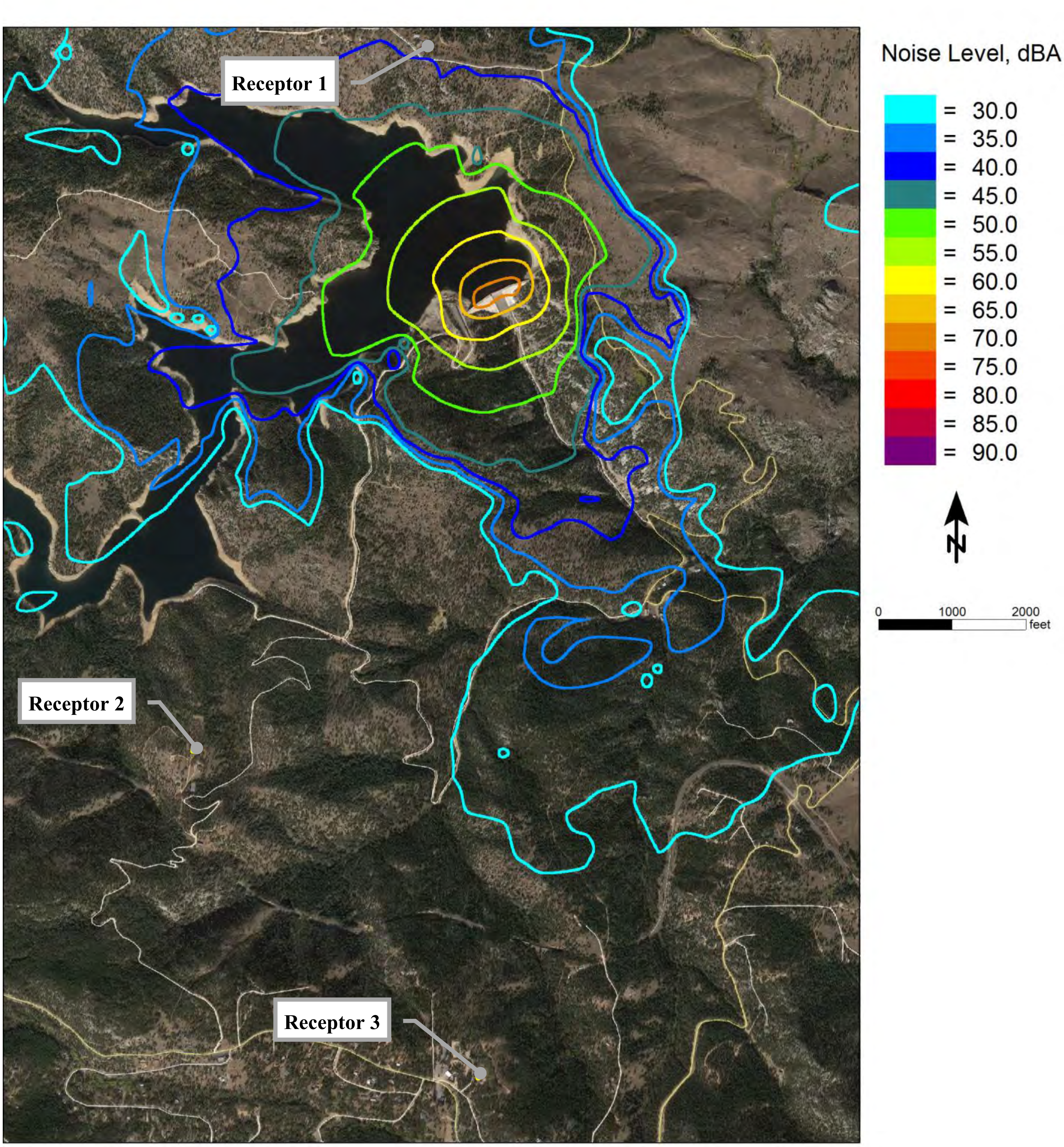
Noise Contour Map of Scenario 6- Construction Evening Years 1-2 (dBA)



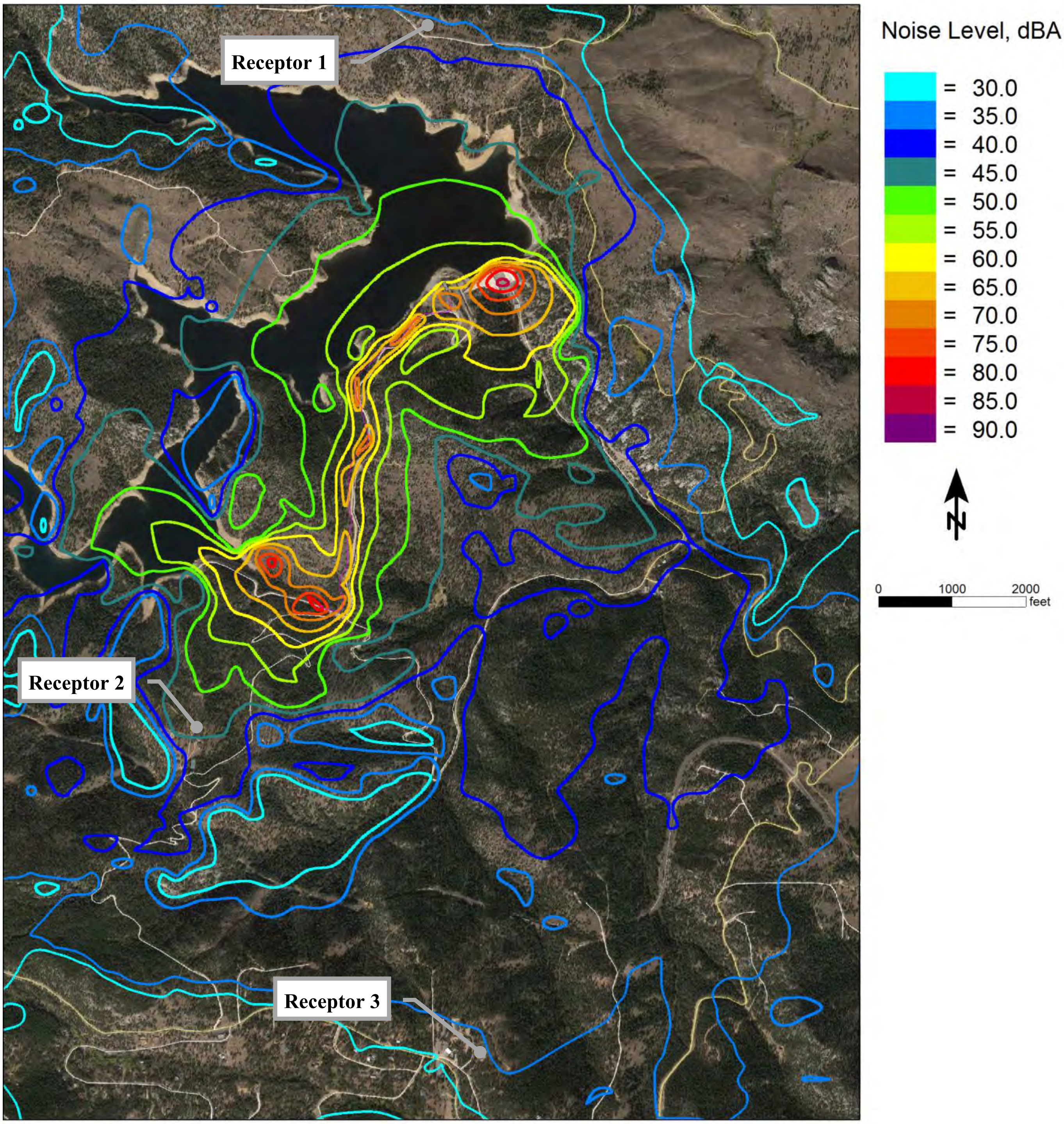
Noise Contour Map of Scenario 6- Construction Evening Year 3 (dBA)



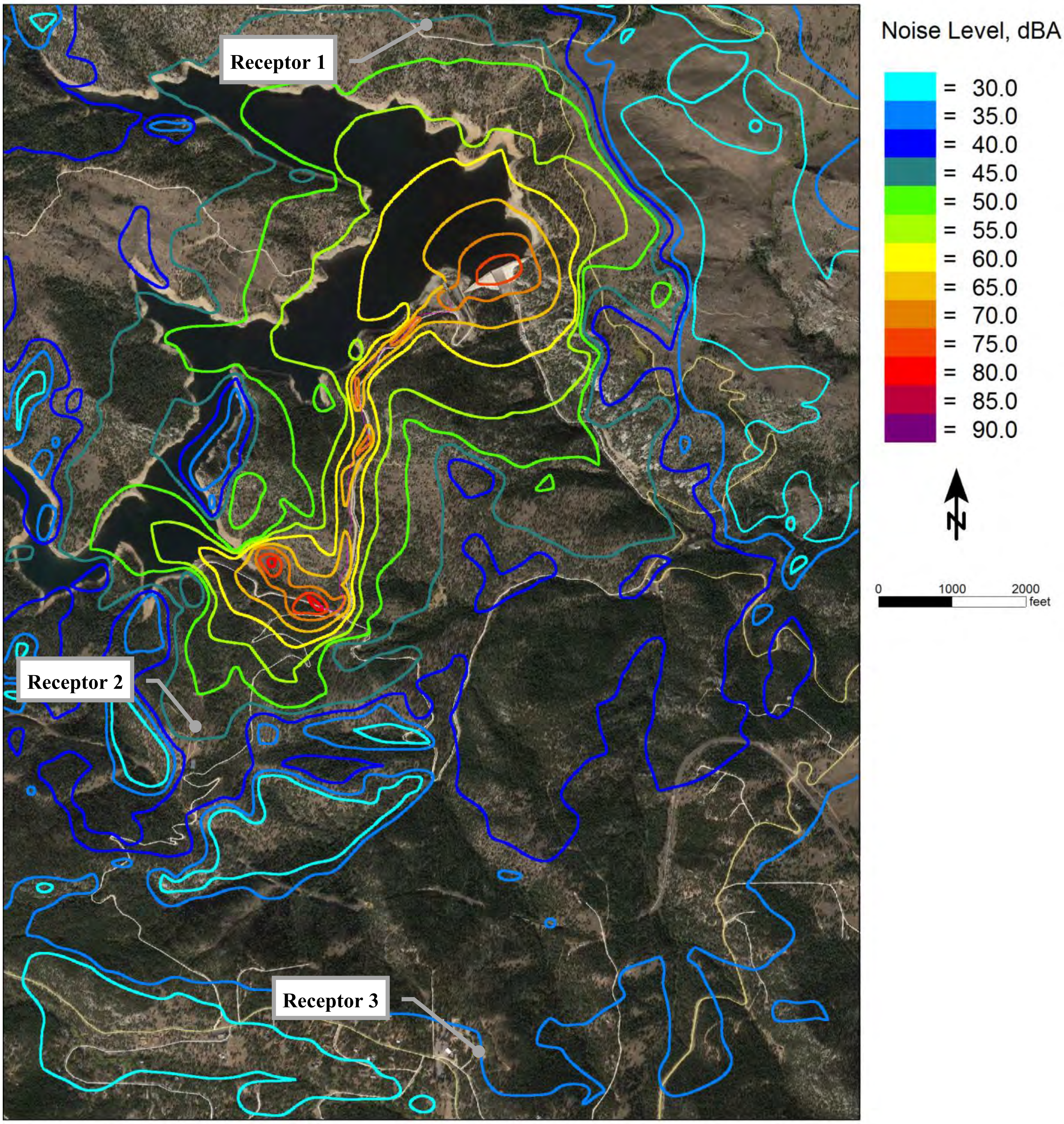
Noise Contour Map of Scenario 7- Construction Nighttime Years 1-2 (dBA)



Noise Contour Map of Scenario 7- Construction Nighttime Year 3 (dBA)



Noise Contour Map of Scenario 3- Osprey Quarry Daytime with Conveyor using Aluminum Idler Rollers Years 1-2 (dBA)



Noise Contour Map of Scenario 3- Osprey Quarry Daytime with Conveyor using Aluminum Idler Rollers Years 3 (dBA)

Attachment 2 - U.S. Army Corps of Engineers – Final Memorandum

Evaluation of the Final Quarry Location Report – May 15, 2017

URS

Final Memorandum

To:	John Urbanic, U.S. Army Corps of Engineers, Omaha District, Denver Regulatory Office	From:	Andrea Parker, Jody Glennon, Courtney Taylor and Caitlin Shaw, URS Corporation
		Date:	May 15, 2017

Subject: **Evaluation of the *Final Quarry Location Report: Impact Minimization and Avoidance Measures, Moffat Collection System Project*, prepared by Denver Water**

Introduction

The City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water) is in the process of obtaining a Clean Water Act (CWA) Section 404 Permit from the U.S. Army Corps of Engineers (Corps) for the proposed Moffat Collection System Project (Project) to place fill material in jurisdictional waters of the U.S. for the construction of a water storage facility associated with developing additional water supplies. In addition to 404 permitting requirements, the Corps determined that analysis of the natural and human environmental effects of the Applicant's Preferred Alternative and a reasonable range of alternatives was necessary to provide full public disclosure and to aid in decision-making as documented in the *Moffat Collection System Project Final Environmental Impact Statement* (FEIS) (Corps 2014). The FEIS was prepared in accordance with the National Environmental Policy Act of 1969, as amended, (NEPA) and the Corps regulations for implementing NEPA (33 Code of Federal Regulations [CFR] 325, Appendix B).

The Applicant's Preferred Alternative (also referred to as the Proposed Action and Project) consists of raising Gross Dam by 131 feet to 471 feet and increasing storage volume in Gross Reservoir from 41,811 acre-feet to approximately 119,000 acre-feet. As described in FEIS Section 2.3.2.1, it was assumed that 60 percent (%) of the material required to make the concrete for the dam raise would be produced onsite and 40% of the remaining material (sand aggregate, flyash, and cement) would be transported from an off-site source. As described in the *Final Quarry Location Report: Impact Minimization and Avoidance Measures, Moffat Collection System Project* (Report) (Denver Water 2016), Denver Water estimates that approximately 930,000 cubic yards of concrete consisting of approximately 90% sand and gravel aggregate and 10% cement and flyash materials would be needed to construct the dam raise and would come from a combination of an on-site quarry and off-site commercial sources.

No site-specific geotechnical evaluations were conducted by Denver Water while the FEIS was being developed. A preliminary geotechnical reconnaissance at the site, however, indicated an on-site granite quarry could produce sand and gravel aggregate material and that cement and flyash would need to be supplied from an off-site source (MWH Americas 2006). For purposes of analysis in the FEIS, it was therefore assumed that an on-site hard rock quarry (FEIS Quarry) would supply the needed gravel aggregate for the Project, shown as the benched/unbenched quarry site on FEIS Figure 2-3. The FEIS Quarry site would impact approximately 29 acres of lands owned by Denver Water and the National Forest System (NFS). Additionally, it was assumed that all of the sand aggregate would be imported to the site from an off-site supplier near Longmont, Colorado (FEIS Figure 2-5). In the FEIS, the Corps acknowledged that more advanced geotechnical analysis may require consideration of alternate on-site quarry locations.

Denver Water conducted preliminary engineering and geotechnical evaluations at Gross Reservoir from 2014-2016 to assess if the native granite underlying the FEIS Quarry could be used to produce aggregate for concrete and if other on-site quarry locations exist that would minimize impacts. In response to comments received by the Corps on the FEIS (Corps 2014), Denver Water proposes to modify the Applicant's Preferred Alternative to minimize adverse impacts identified in the FEIS. The proposed modifications to the Applicant's Preferred Alternative are related to changes to the FEIS Quarry site as described in the Report (Denver Water 2016).

The Report summarized the findings from the preliminary engineering evaluations completed by Denver Water for the purposes of reducing: 1) impacts to NFS lands, 2) number of surface acres requiring mitigation or reclamation, 3) visual impacts to the viewshed of residences and recreationists around Gross Reservoir, and 4) impacts associated with trucking in aggregates from off-site commercial sources. The findings of the preliminary engineering reports showed that all aggregate (sand and gravel) could be produced onsite and that the FEIS Quarry could be located entirely on Denver Water property within the new reservoir inundation pool. The relocated quarry site would occur along the existing access road (shown as Haul Road Recreation Area on FEIS Figure 3.15-1) to Osprey Point (Osprey Point Quarry).

Comparison of Resource Impacts between the FEIS Quarry and Osprey Point Quarry Sites

The Report provides a comparative analysis by Denver Water of the potential impacts associated with the FEIS Quarry site to the Osprey Point Quarry for the Applicant's Preferred Alternative. All resources described and evaluated in Chapters 3, 4, and 5 of the FEIS were independently assessed by URS in relation to the proposed change in quarry location described in the Report. In general, the Corps/URS agree that the Osprey Point Quarry site and associated features (e.g., spoil area) would result in no impacts, have similar impacts to the FEIS Quarry, or have reduced impacts due to a reduction in land disturbance and off-site haul trips.

Resources Not Applicable to Analysis

Channel Morphology – FEIS Section 5.3 indicates that channel morphology would not be impacted by construction activities at Gross Reservoir. Rather, Project impacts to channel morphology are associated with flow changes and not construction and operation of the FEIS Quarry. The Corps/URS agree that no permanent or temporary impacts to channel morphology are anticipated from either the FEIS Quarry site or the Osprey Point Quarry site.

Resources with no Permanent, Temporary, or Cumulative Impacts

Surface Water – The Corps/URS agree that no permanent, temporary, or cumulative impacts to surface water would occur from the construction and operation of the Osprey Point Quarry site since the analysis for it is similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.1 and 5.1 and Appendix H. The change in quarry location would not create impacts to surface water hydrology (e.g., stream flows in South Boulder Creek and tributaries that feed into Gross Reservoir; the surface area, volume or level of Gross Reservoir; floodplain changes). No cumulative effects to surface water were identified for the FEIS Quarry site; similarly, no cumulative effects to surface water would result from the construction and operation of the Osprey Point Quarry site.

Water Quality – The Corps/URS agree that no permanent, temporary, or cumulative impacts would occur to water quality from the construction and operation of the Osprey Point Quarry site and associated spoil area since the analysis for it is similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.2 and 5.2. Both quarry sites are underlain by similar geology (FEIS Section 3.5.1.1; Figure 3.5-1), primarily Precambrian Boulder Creek granodiorite and quartz filled veins, which are unanticipated to create water quality issues if exposed during quarry activities. Additionally, the Colorado Department of Public Health and Environment (CDPHE), a Cooperating Agency on the Project, issued a CWA 401 Certification for the Project in June 2016. The 401 Certification did not cite concerns or conditions with any water quality issues related to quarry activities at Gross Reservoir. No cumulative effects to water quality were identified for the FEIS Quarry site; similarly, no cumulative effects to water quality would result from the construction and operation of the Osprey Point Quarry site.

Groundwater – The Corps/URS agree that no permanent, temporary, or cumulative impacts would occur to groundwater from the construction and operation of the Osprey Point Quarry site and associated spoil area since the analysis for it is similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.4 and 5.4. It is not anticipated that the change in quarry location would impact groundwater. No cumulative effects to groundwater were identified for the FEIS Quarry site; similarly, no cumulative effects to groundwater would result from the construction and operation of the Osprey Point Quarry site.

Aquatic Biological Resources – The Corps/URS agree that no permanent, temporary, or cumulative impacts would occur to special status species from the construction and operation of the Osprey Point Quarry site and associated spoil area since the analysis for it is similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.11 and 5.11. It is not anticipated that the change in quarry location would impact aquatic biological resources in and around Gross Reservoir. No cumulative effects to aquatic biological resources were identified for the FEIS Quarry site; similarly, no cumulative effects to aquatic biological resources would result from the construction and operation of the Osprey Point Quarry site.

Cultural/Historical/Paleontological Resources – The Corps/URS agree that no permanent, temporary, or cumulative impacts would occur to cultural/historical/paleontological resources from the construction and operation of the Osprey Point Quarry site and associated spoil area since the analysis for these resources is similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.18 and 5.18 and Appendix L. It is not anticipated that the change in quarry location would impact cultural resources around Gross Reservoir since both sites are located within the Area of Potential Effects (APE) that was evaluated in the FEIS. Denver Water has entered into a Programmatic Agreement (PA) (FEIS Appendix L) with the Corps, Colorado State Historic Preservation Officer (SHPO), Advisory Council on Historic Preservation (ACHP) and the U.S. Forest Service (USFS) to account and mitigate for any unknown cultural/historical/

paleontological resources potentially encountered during construction, including quarry activities. No cumulative effects to cultural/historical/paleontological resources were identified for the FEIS Quarry site; similarly, no cumulative effects to cultural/historical/paleontological resources would result from the construction and operation of the Osprey Point Quarry site.

Hazardous Materials – The Corps/URS agree that no permanent, temporary, or cumulative impacts from hazardous materials are anticipated to occur from the construction and operation of the Osprey Point Quarry site and associated spoil area since the analysis for these materials is similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.20 and 5.20. It is not anticipated that the change in quarry location would create impacts from hazardous materials in and around Gross Reservoir. No cumulative effects to hazardous materials were identified for the FEIS Quarry site; similarly, no cumulative effects to hazardous resources would result from the construction and operation of the Osprey Point Quarry site.

Resources with the Same or Similar Permanent, Temporary, and Cumulative Impacts as the FEIS

Geology – The Corps/URS agree that the permanent, temporary, and cumulative impacts to geologic resources from the construction and operation of the Osprey Point Quarry site would be similar those for the FEIS Quarry site as discussed in FEIS Sections 4.6.5 and 5.5. Both quarry sites are underlain by similar geology (FEIS Section 3.5.1.1; Figure 3.5-1), primarily Precambrian Boulder Creek granodiorite and quartz filled veins. The Osprey Point Quarry site would result in approximately 370,000 cubic yards more of unavoidable geologic losses than the FEIS Quarry site, but the disturbance area required to quarry the material would be almost half the surface size (i.e., the Osprey Point Quarry is 14-16 acres and the FEIS Quarry is 29 acres). FEIS Section 5.5 also generally presents an evaluation of potential geologic hazards related to seismicity and landslides. More recent geophysical seismic analysis conducted by Denver Water's contractors concluded that the Roger's Fault either does not exist in the Osprey Point Quarry site area or is not active and is unlikely to compromise dam safety at Gross Reservoir (Olson Engineering 2015). Additionally, Denver Water is required to comply with the Federal Energy Regulatory Commission (FERC) Division of Dam Safety and Inspection and would develop a dam safety plan prior to construction.

The FEIS Quarry and other construction activities associated with the Applicant's Preferred Alternative and other reasonable foreseeable future actions (RFFAs) would contribute to the unavoidable loss of geological resources resulting in a minor cumulative effect. Cumulative effects to geologic resources from the Osprey Point Quarry site would result in the same or slightly less cumulative impacts than those for the FEIS Quarry site due to the smaller disturbance area.

Riparian and Wetlands Areas – The Corps/URS agree that the permanent, temporary, and cumulative impacts to riparian and wetland areas from the construction and operation of the Osprey Point Quarry site would be similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.8 and 5.8. No wetland, riparian, or Other Waters of the U.S. were identified within the FEIS Quarry area (FEIS Figure 3.8-1). The proposed Osprey Point Quarry site spoil area, however, would impact approximately 0.02 acre of a Palustrine Scrub-Shrub (PSS) wetland located along the Gross Reservoir shoreline; inundation impacts associated with an enlarged Gross Reservoir to this same wetland was accounted for in the FEIS. Additionally, two woodland/shrubland riparian areas occur within the FEIS Quarry site compared to three woodland/shrubland riparian areas within the proposed Osprey Point Quarry site; impacts to these five woodland/shrubland riparian areas were accounted for in the FEIS due to inundation from the enlarged reservoir pool. Thus, impacts to wetlands, Other Waters of the U.S., and riparian areas would be the same regardless of the two quarry locations and would be fully mitigated in accordance with the Corps' current mitigation policies and associated conditions of the Section 404 Permit.

The FEIS Quarry site and related construction activities associated with the Applicant's Preferred Alternative would result in the permanent impacts of wetlands and riparian areas that would be fully mitigated. Similarly, the cumulative effects to wetlands and riparian areas from the construction of the Osprey Point Quarry site and related construction activities would be fully mitigated to ensure no net loss of these resources.

Noise – The Corps/URS agree that the permanent, temporary, and cumulative impacts to noise from the construction and operation of the Osprey Point Quarry site would be similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.14 and 5.14. On-site construction related noise is unavoidable and was identified as a moderate temporary impact in the FEIS. It is anticipated that the change in location to the Osprey Point Quarry site would result in similar moderate temporary noise impacts since the processing activities used to produce sand and gravel aggregate is similar to what was assumed for the impact analysis in the FEIS. Similarly, the blasting frequency would increase from every three to four days (FEIS Section 2.3.2.1) to up to one blast per day, but the timeframe (approximately the first year of aggregate processing and in the early phases of construction related to the dam foundation excavation) for blasting would be similar to what was described in the FEIS. Off-site noise impacts associated with haul trucks would be reduced by 72% (truck trip calculations are provided on the revised Traffic Trips table on page 5 of Denver Water's Report) compared to what was presented in FEIS Sections 2.8.5 and 5.12. Overall, it is not anticipated that State of Colorado noise standards (Colorado Revised Statutes [C.R.S.] Title 25-12-103) or Boulder County noise ordinances (Boulder County 1992)would be exceeded onsite at either quarry location with the exception of the periodic exceedance of the U.S. Environmental Protection Agency (USEPA) noise threshold level of 70 A-weighted decibels (dBA); the Corps acknowledges that off-site noise impacts would be reduced due to associated decreases in haul truck trips.

Construction activity associated with the FEIS Quarry site would result in minor to moderate cumulative effects to on-site noise and construction traffic. The cumulative noise effects associated with Osprey Point Quarry site would be the same or less than those for the FEIS Quarry site due to the reduction in off-site haul truck traffic.

Recreation – The Corps/URS agree that the permanent, temporary, and cumulative impacts to recreation resources from the construction and operation of the Osprey Point Quarry site would be similar to the analysis conducted for the FEIS Quarry site in FEIS Sections 4.6.15 and 5.15. The FEIS identified temporary impacts to recreational activities at Gross Reservoir due to the periodic closure of the Haul Road Recreation Area (Osprey Point) shown on FEIS Figure 5.15-2; similar temporary closures of recreational areas would be required for construction activities at the Osprey Point Quarry site. Both quarry areas would re-open to recreation upon completion of construction activities for the relocated Haul Road Recreation Area and scenic trails, but the Osprey Point Quarry site would be less visible to recreationists since it would be submerged under the new high water line.

Construction activity for the FEIS Quarry site and other RFFAs would likely result in minor, if any, cumulative effects to recreational activities at Gross Reservoir. Cumulative effects to recreation associated with the Osprey Point Quarry site are anticipated to be the same as the cumulative effects for the FEIS Quarry since the same existing recreational facilities (e.g., Haul Road Recreation Area) would need to be relocated.

Socioeconomics – The Corps/URS agree that the permanent, temporary, and cumulative impacts to socioeconomic resources from the construction and operation of the Osprey Point Quarry site would be similar to those for the FEIS Quarry site as described in FEIS Sections 4.6.19 and 5.19. The FEIS analysis concluded that temporary, minor, beneficial socioeconomic improvements would result for the Project area due to the addition of new construction jobs and revenue from the purchase of materials and supplies. The FEIS also identified that short-term minor to moderate construction-related impacts would occur to residents living within the Gross Reservoir Primary Impact Area (PIA). In general, the construction activities at the Osprey Point Quarry site would be similar to those at the FEIS Quarry site and would produce similar short-term economic benefits. The Osprey Point Quarry site, however, would likely result in fewer impacts to the residents in the PIA due to the 72% reduction of haul trucks on local roads and the improved post-construction scenic viewshed at the new quarry location.

No cumulative effects to socioeconomics from the FEIS Quarry site and other construction-related activities for the Project are anticipated since Gross Reservoir is primarily surrounded by NFS lands, residential lands, and other similar lands where significant future development is unlikely. Similarly, no cumulative effects are anticipated from construction activities at the Osprey Point Quarry site since the quarry activities would be similar to those at the FEIS Quarry site.

Special Status Species – The Corps/URS agree that the permanent, temporary or cumulative impacts to federal or state listed special status species and Forest Service Region 2 (Rocky Mountain Region) sensitive species from the construction and operation of the Osprey Point Quarry site and associated spoil area would be similar to those presented for the FEIS Quarry site in FEIS Sections 4.6.10 and 5.10.

Slightly greater impacts, however, than those described in the FEIS from the FEIS Quarry site would occur from the Osprey Point Quarry site to Arapaho & Roosevelt National Forests plant species of local concern that were identified during field surveys conducted at Gross Reservoir in 2010 (as described in the document titled *Report Responding to USFS Comments* [FEIS Appendix G-3]). More specifically, a small population of Maryland sanicle (*Sanicula marilandica*) was identified in one of the drainages on the south side of Gross Reservoir, on the south side of the Osprey Point Quarry site and is located entirely on Denver Water land. This species occurred in areas of moderate shade along the edges of the creek. All of this population is located on Denver Water or private land, and not on NFS lands. Based on the 2010 survey, an additional 11 Maryland sanicle individuals would be affected at the Osprey Point Quarry site (FEIS Appendix G-3, Map 8). The USFS (Popovich 2011) recommended the following mitigations for impacts to Maryland sanicle at Gross Reservoir: 1) collect seed from affected plants and spread seed in suitable nearby unaffected habitat, and 2) conduct surveys to document additional individuals that would not be affected upstream of the known location on private land not owned by Denver Water.

No cumulative effects to federal or state special status species, Forest Service Region 2 sensitive species or Arapaho & Roosevelt National Forests species of local concern are anticipated from the FEIS Quarry site and other construction-related Project activities. Likewise, no cumulative effects would likely result from the Osprey Point Quarry site since the sensitive species and associated habitat are the primarily the same as those evaluated for the FEIS Quarry site. Although greater impacts to Maryland sanicle may occur from the construction and operation of the Osprey Point Quarry site, it is not anticipated that overall health of the local population would be cumulatively impacted if the recommended mitigation is implemented.

Resources with Reduced Permanent, Temporary, or Cumulative Impacts than the FEIS

Soils – The Corps/URS agree that less permanent, temporary, or cumulative impacts would occur to soils from the construction and operation of the Osprey Point Quarry site and associated spoil area than the FEIS Quarry site. Soil impacts for the FEIS Quarry site are described in FEIS Sections 4.6.6 and 5.6. The same soil units were evaluated as part of the affected environment for both quarry locations (FEIS Appendix F) and have very similar characteristics. Overall, unavoidable soil losses are likely to occur at both quarry locations from inundation of the enlarged reservoir pool and erosion from exposed soils after vegetation removal and wave action along the shoreline. Reduced erosion is likely to occur to at the Osprey Point Quarry site; however, since the slopes are less steep than those at the FEIS Quarry site and about half the land would be disturbed (i.e., the Osprey Point Quarry is 14-16 acres and the FEIS Quarry is 29 acres).

Minimal cumulative effects are anticipated from the soil losses associated with the proposed construction of Project facilities, including the FEIS Quarry site, since soil impacts can be minimized with the implementation of appropriate Best Management Practices (BMPs). Cumulative effects to soils at the Osprey Point Quarry site would be even less since the area of surface disturbance is about half the size as the FEIS Quarry site.

Vegetation – The Corps/URS agree that less permanent, temporary, or cumulative impacts would occur to vegetation from the construction and operation of the Osprey Point Quarry site and associated spoil area than the FEIS Quarry site. FEIS Quarry site vegetation impacts are described in FEIS Sections 4.6.7 and 5.7. Both of the quarry sites consist of coniferous forest land comprised of Ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) evergreen communities that would be unavoidably lost during construction activities. Reduced impacts would occur at the Osprey Point Quarry site when compared to the FEIS Quarry site, however, since it is about half the size of the FEIS Quarry site (i.e., the Osprey Point Quarry is 14-16 acres and the FEIS Quarry is 29 acres). Additionally, the Osprey Point Quarry site is located entirely on land owned by Denver Water, thus vegetation on NFS lands would not be lost from quarry activities.

No cumulative impacts to vegetation are anticipated at the FEIS Quarry site. Likewise, no cumulative impacts to vegetation are anticipated at the Osprey Point Quarry site since construction activities would be similar those evaluated for the FEIS Quarry site and about half the area would be disturbed.

Wildlife – The Corps/URS agree that less permanent, temporary, or cumulative impacts would occur to wildlife from the construction and operation of the Osprey Point Quarry site and associated spoil area than the FEIS Quarry site. FEIS Quarry site wildlife impacts are described in FEIS Sections 4.6.9 and 5.7. Permanent direct impacts are associated with the loss or degradation of habitat from vegetation clearing and reservoir inundation as well as the potential mortality from construction activities and truck traffic. Reduced impacts to wildlife and their associated habitat would occur at the Osprey Point Quarry site than the FEIS Quarry site because less area (i.e., approximately half) would be disturbed (i.e., the Osprey Point Quarry is 14-16 acres and the FEIS Quarry is 29 acres). Regardless of quarry location, temporary impacts to wildlife would include displacement from construction noise, particularly during blasting activities.

No cumulative impacts to wildlife and associated habitat are anticipated at the FEIS Quarry site and spoil area. Similarly, no cumulative effects to wildlife would occur from the Osprey Point Quarry site since the habitat and the construction activities would be the same as those for the FEIS Quarry site.

Transportation – The Corps/URS agree that less permanent, temporary, or cumulative impacts would occur to traffic volume and roads from the construction and operation of the Osprey Point Quarry site and associated spoil area than the FEIS Quarry site. Transportation-related impacts are described in FEIS Sections 4.6.12 and 5.12. Based on recent engineering and geotechnical evaluations, Denver Water determined that all sand and gravel aggregate could be produced onsite at either quarry location (ASI 2015) leading to a 72% reduction in haul truck trips. The travel trips associated with the construction workforce, construction equipment, and tree removal and disposal as described in FEIS Section 5.12.1 would remain the same for both quarry locations. Additionally, Denver Water also determined that the temporary haul road needed to transport the aggregate materials onsite between the stockpile areas and the dam could be 10 feet less wide (40 feet) than presented in the FEIS, thus further reducing transportation impacts. Based on the reduced off-site truck trips and reduced footprint of the on-site haul road as previously described, the Corps/URS confirmed that transportation impacts would be reduced compared to those described in the FEIS.

Minimal cumulative effects to transportation are anticipated from Project-related construction activities, including the FEIS Quarry site, and were identified in FEIS Section 4.6.12. Production of all sand and gravel aggregate material onsite would further minimize cumulative transportation impacts from both the FEIS Quarry site and Osprey Point Quarry site due to the reduction of construction truck trips.

Land Use – The Corps/URS agree that less permanent, temporary, or cumulative land use impacts would occur from the construction and operation of the Osprey Point Quarry site and associated spoil area than the FEIS Quarry site. Land use impacts are described in FEIS Sections 4.6.16 and 5.16. As shown on FEIS Figure 2-3, the FEIS Quarry is located on existing Denver Water land (5 acres) and NFS lands (24 acres); the Osprey Point Quarry site is located entirely on lands owned by Denver Water and is approximately half the size of the FEIS Quarry site. Regardless of quarry location, temporary impacts to adjacent lands (e.g., Lakeshore and Miramonte subdivisions) from construction noise are likely to occur.

Negligible cumulative impacts to existing and future land uses at the FEIS Quarry site and spoil area are anticipated. Cumulative impacts to land uses at the Osprey Point Quarry site would be less than those for the FEIS Quarry since approximately half of the land would be disturbed.

Visual Resources – The Corps/URS agree that less permanent, temporary, or cumulative impacts would occur to visual resources from the construction and operation of the Osprey Point Quarry site and associated spoil area than the FEIS Quarry site. Visual resource impacts are described in FEIS Sections 4.6.17 and 5.17. Both quarry sites would be temporarily exposed during construction activities; however, the FEIS Quarry would remain exposed upon completion of construction and permanently impact the scenic quality of Gross Reservoir (FEIS Figure 5.17-1 and Report Figure 1). The Osprey Point Quarry would be almost or entirely submerged below the new high water line once the reservoir is enlarged (Report Figure 2).

Minor to moderate cumulative effects to the visual quality at Gross Reservoir would occur from the Applicant's Preferred Alternative due the exposure of the FEIS Quarry site above the high water line and the development of the auxiliary spillway. The Osprey Point Quarry site would result in reduced cumulative impacts to visual resources since the quarry would be almost entirely or entirely submerged under the new high water line.

Air Quality – The air quality analysis described in the Report accurately represents the anticipated changes to air quality effects due the relocation of the quarry site. Attachment 2 of the Report presents how the FEIS emissions calculations would be affected by the change in the quarry location. The primary changes are the number of supply truck trips and estimated volume of rock crushed. With the exception of particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), the Applicant's Preferred Alternative emissions from all criteria pollutants, hazardous pollutants (HAPs), and greenhouse gases (GHGs) would be reduced by a small amount if the quarry location is moved from the FEIS Quarry site to the Osprey Point Quarry site. While both particulate matter less than 10 microns in diameter (PM_{10}) and $PM_{2.5}$ are anticipated to increase from the FEIS Quarry site to the Osprey Point Quarry site due to the increased volume of rock crushed, the net total Applicant's Preferred Alternative PM_{10} emissions are estimated to decrease because the decreased truck trips would more than compensate for the increased emissions from rock crushing. However, the net total Applicant's Preferred Alternative $PM_{2.5}$ emissions are estimated to increase slightly because the emission increases from rock crushing would be larger than the emission decreases from truck trips. To more clearly show the expected change in the air emissions associated with the new quarry location, FEIS Quarry Applicant's Preferred Alternative emissions are shown in Table 1 and compared to the estimated emissions for the Osprey Point Quarry site.

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Table 1. Comparison of the FEIS Quarry Emissions Estimates to the Osprey Point Quarry Site Emission Estimates

	Criteria Pollutants						Hazardous Air Pollutants						GHGs
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	1, 3 Butadiene	Acetaldehyde	Benzene	Formaldehyde	Toluene	Total HAPs	CO_2e
Osprey Point Quarry Site: Total Project Emissions (tons)	474.59	402.65	243.79	85.52	11.13	57.42	0.05	0.15	0.27	0.30	0.07	0.84	26,598.73
FEIS Quarry Site: Total Project Emissions (tons)	494.36	423.44	315.79	79.37	12.04	60.06	0.07	0.18	0.32	0.40	0.07	1.04	26,606.32
Difference Between Osprey Point Quarry and FEIS Quarry Total (tons)	-19.77	-20.79	-72	6.15	-0.91	-2.64	-0.02	-0.03	-0.05	-0.10	0.00	-0.2	-7.59
Osprey Point Quarry: Average Annual Emissions (tons/year)	115.75	98.21	59.46	20.86	2.71	14	0.01	0.04	0.07	0.07	0.02	0.2	6,487.50
FEIS Quarry: Average Annual Emissions (tons/year)	120.58	103.28	77.02	19.36	2.94	14.65	0.02	0.04	0.08	0.10	0.02	0.25	6,489.35
Difference Between Osprey Point Quarry and FEIS Quarry Total (tons/year)	-4.83	-5.07	-17.56	1.50	-0.23	-0.65	-0.01	0.00	-0.01	-0.03	0.00	-0.05	-1.85

Notes:
CO = carbon monoxide
Co_2e = carbon dioxide equivalent
GHG = greenhouse gas
HAP = hazardous air pollutant
NO_x = oxides of nitrogen
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
PM_{10} = particulate matter less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compounds

Overall, the Corps/URS agrees that the quarry site relocation would not change the air quality impacts from the Applicant's Preferred Alternative or cumulative effects as described in the FEIS. In addition, the Report appropriately states that regardless of the quarry location, the Applicant's Preferred Alternative would result in temporary, direct impacts, primarily due to construction activities. Furthermore, the Corps/URS agrees that the cumulative air quality impacts from the Applicant's Preferred Alternative, regardless of the quarry location, would be negligible as the direct impacts are temporary and are expected to be minor.

Clean Air Act General Conformity

The Clean Air Act's General Conformity (40 CFR Part 93, Subpart B) provisions require Federal agencies to ensure that planned Federal actions located in an area designated "non-attainment" or "maintenance" for air quality criteria pollutants do not impair State and local efforts to improve or maintain air quality. The Federal agency responsible for approving an action is required to determine if the action conforms to the applicable non-attainment or maintenance area State Implementation Plan (SIP). For the Moffat Project, the Corps is responsible for determining if the Applicant's Preferred Alternative conforms to the SIP.

The General Conformity process is broken down into two steps that must be completed prior to commencement of a Federal action. As part of Step 1, a conformity review is completed to determine if *de-Minimis* or regional significance thresholds are exceeded. The conformity review consists of two parts:

1) an applicability analysis to determine whether an action meets a regulatory exemption, and
2) if the action is not exempt, to determine if either:
    a) the *de-Minimis* thresholds are exceeded, or
    b) the project is 10% or more of the area's total emissions inventory.

If the project is not exempt and either exceeds the *de-Minimis* thresholds or 10% of the area's emissions inventory, General Conformity regulations apply to the action and Step 2, a conformity determination, must be performed.

The Applicant's Preferred Alternative is located within an ozone non-attainment area and a carbon monoxide (CO) and PM_{10} maintenance area. Therefore, a conformity review is required for oxides of nitrogen (NO_x) and volatile organic compounds (VOC), ozone precursors, as well as, CO and PM_{10}. A conformity review was conducted for the Applicant's Preferred Alternative after incorporating the proposed quarry location changes described in the Report. No emissions sources or activities planned as part of the Applicant's Preferred Alternative meet regulatory exceptions to General Conformity requirements; therefore, the emissions inventory was reviewed and compared with applicable thresholds.

The Emissions Inventory for the Applicant's Preferred Alternative was modified for the purposes of the conformity review. Specifically, care was taken to evaluate the potential peak emissions in order to characterize the maximum annual emissions instead of annual average emissions. Also, emission factors for construction equipment were updated based on input from Denver Water to be consistent with newer, lower emission, equipment planned to be used during Project construction.[1]

As part of the conformity review, the maximum Project year emissions were calculated by source, as shown in Table 2. In order to characterize the maximum annual emissions, each source type was calculated separately since the duration of the planned activities varies by source type. The yearly emissions by source are summed to determine the total maximum Project year emissions. The maximum yearly emissions by source type, total maximum Project year emissions, and *de-Minimis* level for NO_x and VOC, CO, and PM_{10} are shown in Table 2. The Project emissions are below the *de-Minimis* levels for all pollutants required to be analyzed for the conformity review.

Table 2. Applicant's Preferred Alternative Maximum Annual Emissions

Source	**Yearly Emissions (tons/year)**			
	CO	**NO_x**	**PM_{10}**	**VOC**
Construction Equipment Exhaust	29.85	55.13	1.75	11.31
Portable Diesel Engine Exhaust	5.16	23.96	1.70	1.91
On-road Exhaust				
Worker Commuting	14.50	1.07	0.03	1.11
Delivery Trucks	2.51	0.03	0.02	0.25
Fugitive Dust				
Wind Erosion	--	--	3.22	--
Blasting	--	--	0.25	--
Paved Roads	--	--	19.37	--
Unpaved Roads	--	--	43.68	--
Rock Crushing/Screening	--	--	2.07	--
Concrete Batching	--	--	13.91	--
Applicant's Preferred Alternative Maximum Project Year Emissions	**52.02**	**80.19**	**86.00**	**14.58**
***De-Minimis* Level**	**100**	**100**	**100**	**100**
Are the Applicant's Preferred Alternative Maximum Emissions Below De-Minimis Level?	*Yes*	*Yes*	*Yes*	*Yes*

The Applicant's Preferred Alternative maximum annual emissions are compared to the Denver Metro and North Front Range Nonattainment Area (NAA) in Table 2. The 2011 and 2017 Denver Metro and NAA emissions are provided from the Technical Support Documents for the Moderate Area 2008 8-Hour Ozone Standard State Implementation Plan[2]. The emissions presented in Table 3 account for all emissions sources within the NAA. The Applicant's Preferred Alternative maximum annual emissions are less than 10% of the 2011 and 2017 NAA emissions

[1] Construction equipment is expected to be manufactured after 2002 which is compliant with Tier 2 non-road engine New Source Performance Standards.

[2] Ramboll and Alpine 2016. Available at: https://raqc.egnyte.com/dl/mm7FkWlbFy/TSD_AQTSD.pdf_

for CO, NO_x and VOC. NAA PM_{10} emissions were not provided; however, it is not anticipated that the PM_{10} emissions for the Applicant's Preferred Alternative will exceed 10% of the PM_{10} NAA emissions.

Since the Project emissions are both below the *de-Minimis* levels and below 10% of the area's emissions inventory for the conformity review, a conformity determination is not required and the Project has been found to conform.

Table 3. Applicant's Preferred Alternative Emissions Compared to Nonattainment Area Total Emissions

Source	Yearly Emissions (tons/year)			
	CO	NO_X	PM_{10}	VOC
Applicant's Preferred Alternative Maximum Project Year Emissions	**52.02**	**80.19**	**86.00**	**14.58**
2011 NAA Total[1]	**622,690.00**	**119,026.50**	**ND**[2]	**251,594.50**
10% of 2011 NAA Emissions	62,269.00	11,902.65	ND[2]	25,159.45
Are the Applicant's Preferred Alternative Maximum Emissions Below 10% NAA Emissions?	*Yes*	*Yes*	*ND*[2]	*Yes*
2017 NAA Total[1]	**513,993.00**	**87,636.50**	**ND**[2]	**189,690.50**
10% of 2017 NAA Emissions	51,399.30	8,763.65	ND[2]	18,969.05
Are the Applicant's Preferred Alternative Maximum Emissions Below 10% NAA Emissions?	*Yes*	*Yes*	*ND*[2]	*Yes*

Notes:
[1] Data from Table 2-2 (Ramboll and Alpine 2016, https://raqc.egnyte.com/dl/mm7FkWlbFy/TSD_AQTSD.pdf)
[2] ND-no data available for PM_{10}.

Council on Environmental Quality Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews

Since the publication of the FEIS in 2014, the Council on Environmental Quality (CEQ) released final guidance for federal agencies on the consideration of GHGs and effects on global climate change within the NEPA documents (CEQ 2016). The final guidance provides a framework for agencies to consider both the effects of a project on climate change, as indicated by its estimated GHG emissions, and the effects of climate on a project. Although the Report does not directly discuss the CEQ guidance, it does disclose the change in the Applicant's Preferred Alternative GHG emissions due to the quarry site relocation. Therefore, the effects of the Project on climate change as suggested by CEQ guidance can be addressed. The release of GHGs would primarily occur during the construction phase of the Project when construction equipment, heavy duty vehicles, and passenger vehicles are in use. It is not anticipated that the relocation of the quarry site would lead to adverse climate effects, as it would reduce the number of supply truck trips and decrease the associated GHG emissions.

To address the second CEQ suggestion that the effects of climate on the Project should be assessed, climate change is assessed over a long time period and on large regional scales.

Although the impact of climate change on the Project area is highly uncertain, precipitation rates, amounts, and timing (i.e., precipitation falling in the form of snow or rain) has the potential to affect the operation of the Project.

As described in FEIS Section 4.6.13, cumulative air quality impacts from the FEIS Quarry site and other construction-related Project activities are anticipated to be negligible, particularly in comparison with other RFFAs that are producing regional emissions from ongoing development. Production of all sand and gravel aggregate material onsite would further minimize cumulative air quality impacts from both the FEIS Quarry site and Osprey Point Quarry site due to the reduction in construction truck trips.

Conclusion

The Corps/URS understand that recent engineering and geotechnical evaluations conducted by Denver Water confirmed that an on-site granite quarry could produce sand and gravel aggregate material and that only cement and flyash would need to be supplied from an off-site source (MWH Americas 2006). Additionally, it was determined that the location of the on-site quarry could be entirely encompassed on lands owned by Denver Water, thus eliminating quarry activities on NFS lands. Based on a review of the Report, the Corps/URS determined that the Osprey Point Quarry site would result in no impacts, have similar impacts as the FEIS Quarry site, or reduced impacts from the FEIS Quarry site due to a reduction in land disturbance and off-site haul trips. More specifically, it is anticipated that no impacts would occur to surface water, water quality, groundwater, aquatic biological resources, cultural/historic/paleontological resources, and hazardous material resources from the Osprey Point Quarry site. Additionally, it was determined that the following resources would have the same or similar impacts as those presented in the FEIS: geology, wetlands and riparian areas, noise, recreation, socioeconomics and special status species. Reduced impacts to several resources would occur due to the change in quarry location from the FEIS Quarry site to the Osprey Point Quarry site including soils, vegetation, wildlife, transportation, land use, visual, and air quality; this reduction in impacts is primarily associated with the Osprey Point Quarry site having a smaller surface area, the reduction in off-site haul truck trips, and improved post-construction scenic quality.

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Attachment 3 – Boulder County Commissioners Letter
(May 8, 2017)

DENVER WATER

1600 West 12th Ave
Denver, CO 80204-3412
303.628.6000
denverwater.org

May 8, 2017

Boulder County Commissioners
P.O. Box 471
Boulder, Colorado 80306

Re: Request To Participate in FERC Dispute Resolution Process

Dear Commissioners Domenico, Gardner and Jones;

On February 1, 2017, the Federal Energy Regulatory Commission ("FERC") issued a combined Notice of Application Accepted and Ready for Environmental Analysis for the proposed amendment to Denver Water's Gross Reservoir Hydroelectric Project (Project No. 2035). The Board of County Commissioners of the County of Boulder ("Boulder County") submitted to FERC a Motion to Intervene, and included in its motion comments regarding Denver Water's Moffat Collection System Project.

Denver Water intends to file its Response to Comments with the FERC by the deadline of May 18, 2017. In the Response, Denver Water will respond to the concerns and issues raised by Boulder County in its Motion to Intervene, along with comments received by FERC from other individuals and organizations.

Recognizing Boulder County's interest and active participation in this Application, Denver Water is requesting that Boulder County engage in settlement discussions with Denver Water utilizing FERC's Dispute Resolution Services (DRS) a free alternative dispute resolution service that is separate from FERC's decisional processes. As explained on FERC's website, https://ferc.gov/about/offices/oaljdr/drs.asp, DRS can become involved in a dispute upon assignment by the Commission or by request of the parties. Based on information that appears on FERC's website, DRS seems to have assisted parties in resolving disputes in an effective and timely manner.

Denver Water remains committed to achieving resolution of issues with Boulder County. Please let us know at your earliest convenience if Boulder County is willing to explore the use of FERC's Dispute Resolution Service together with Denver Water.

Respectfully,

James S. Lochhead
CEO/Manager

Attachment 4 – Gross Dam Reservoir Expansion Traffic Control Plan (December 2015)

DENVER WATER

Gross Dam Reservoir Expansion Traffic Control Plan

12/16/2015

Contents

Executive Summary

The Traffic Control Plan (TCP) presented within this report provides a background on the Gross Dam Reservoir Expansion Project and the transportation challenges associated with building a large scale project such as this. This project is being constructed in a rural mountain canyon environment where transportation of raw materials such as cement is not an everyday occurrence. The challenges faced in a narrow canyon environment include roadway geometric constraints that create the perception of slow moving trucks and make it difficult for trucks to navigate the roadway, steep grades that make it challenging for larger vehicles to accelerate, and safety concerns related to truck to truck interactions and truck to passenger vehicle interactions.

This traffic control plan has been developed to address the concerns related to truck traffic and to increase public awareness of trucking in the corridor. This plan provides a basic understanding of the existing traffic conditions along SH 72 and an overview of the material hauling and construction traffic and the impacts caused by both. The bulk of this report provides an explanation of recommended traffic control devices that will alert the public of when active hauling is ongoing and also when and where flagging operations are ongoing and only permit one-way travel on a roadway. These devices also serve to warn the public of additional construction traffic that may be present outside of the hauling route. These devices include dynamic signs that can change messages, as well as static signs with flashing beacons that can be turned off and on during active hauling hours. These devices are proven and effective devices that increase driver awareness without drivers becoming immune to them, such as with typical roadway signs that are seen along corridors similar to SH 72 and Gross Dam Road. In addition to recommendations for traffic control devices, this plan also makes recommendations for the maintenance of striping along SH 72, and how all of these traffic measures should be supervised. The final element of this plan describes additional maintenance considerations such as the condition of the roadway surface and the presence of dust, and the recommendations for handling both.

Section 1 Introduction and Purpose of Traffic Control Plan

The purpose of the Gross Dam Expansion Traffic Control Plan (TCP) is to layout appropriate traffic control devices to promote highway safety and mitigate the impacts created by the increased trucking required for the delivery of cement and fly ash to the construction site. These additional deliveries will be done with bulk haul trucks along the designated haul route. One of the most important and stated goals for the Gross Dam Reservoir Expansion Project is to maintain safety. The volume of trucks needed for the importation of raw materials is described in detail in the next section of the report.

The intent of this traffic control plan is to increase overall awareness of the additional trucks that will be on the corridor, to increase awareness of the potential for bicyclists to be present on the corridor, and to handle areas where two-way traffic is not feasible due to narrow roadways and tight roadway curvature. Additional goals of this traffic control plan include addressing existing striping along the corridor, providing an overview of existing traffic conditions on SH 72, and discussing maintenance needs related to the roadway surface and dust creation.

Figure 1-1: Photo of Bulk Cement Delivery Truck

The traffic control devices recommended by this plan will notify road users about additional truck traffic and provide warning and guidance needed to maintain safe operating conditions on the roadway. Traffic control devices recommended in this plan include dynamic signing and standard static signing measures.

Figure 1-2: Permanent Variable Message Sign

Dynamic signs are commonly referred to as variable message signs and are utilized extensively by the Colorado Department of Transportation (CDOT). These signs can either be installed with permanent foundations or they can be portable and trailer mounted. These signs are effective in communicating short and descriptive messages that inform the public of changing conditions. In the case of this project, the signs can serve to indicate whether or not active hauling is in progress.

Figure 1-3: Standard Static Sign Example

Standard static signs are commonly used on construction projects. Static signs follow the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways and standard CDOT practices. It is the projects intent to utilize flashing beacons with many of the static signs that can also be turned off or on depending on active hauling hours. The signs, and devices with the signs, are described in detail in Section 4 Traffic Control Measures.

Dynamic and static signs are proposed along SH 72 or Coal Creek Canyon Road and Gross Dam Road (Boulder County Road 77s). The majority of the signage is intended, as stated above, to warn and guide drivers through these roads safely with the presence of additional truck traffic. In addition to the warning and guidance signs on SH 72 and Gross Dam

Road, there are also locations along Gross Dam Road where two way traffic cannot be accommodated due to the narrow roadway and sharp roadway curvature. At these locations traffic safety will be maintained via the use of flaggers or interconnected traffic signals and one-way traffic when a truck is present.

This TCP is an element required for the Federal Energy Regulatory Commission (FERC) Permit Application Process. The TCP demonstrates how the impacts of additional truck traffic required for the construction of the project can be mitigated and sets out a plan to provide pro-active communication with the traveling public and the residents of Coal Creek Canyon. The TCP is based upon multi agency coordination. Meetings with CDOT, Boulder County, and Jefferson County have occurred and will continue to take place to discuss the impacts of and the mitigation methods for additional truck traffic along SH 72 and Gross Dam Road.

Section 2 Project Background

The existing Gross Dam is an on-stream facility located on South Boulder Creek in Boulder County, Colorado, in the Arapahoe-Roosevelt National Forest. The dam is owned and operated by Denver Water and provides raw water storage from both west slope trans-continental diversions and from the South Boulder Creek watershed upstream of Gross Dam.

The 340-foot tall dam was constructed by Denver Water to provide municipal water storage for the City and County of Denver and surrounding communities. When the dam was originally constructed in the early 1950s, the surrounding area was sparsely populated and has since grown to over 2,400 people. The largest community near Gross Reservoir is known as Coal Creek Canyon, named after Coal Creek, and is located in Boulder, Jefferson, and Gilpin counties. Coal Creek Canyon's primary access and thoroughfare is Colorado State Highway 72 (SH 72) which generally follows Coal Creek through the canyon. Although there are other access routes in and out of the canyon, SH 72 is critical to the community and provides the only direct access to many businesses, residences, and neighborhoods in the canyon. SH72 is also the primary route to access Gross Dam and the reservoir.

The current project proposes to raise Gross Dam by 131 feet to a final height of 471 feet, increasing storage volume from 41,811 acre-feet to about 118,811 acre-feet. The raised dam and expanded Gross Reservoir will provide a reliable and dependable water supply for Denver Water Customers.

In order to raise the dam the project will need to import cement and fly ash. The Environmental Impact Statement (EIS) assumed the aggregates would be obtained through a combination of onsite and offsite sources. The Final EIS assumed the worst case, which is that all fine aggregate will be imported from several commercial sand and gravel quarries near Longmont, Colorado. Further investigations have determined that the fine aggregate will be quarried onsite, leaving only the need for cement and fly ash to be imported. With the fine aggregate being produced onsite, the project will not require an estimated 23,600 tractor trailer trucks, thereby reducing the anticipated number of trucks originally planned in the EIS.

The timeframe of this project is as shown in Table 2-1.

Timeframe	Activity
2015-2017	Dam's final engineering design.
2017-2018	Construction of any roadway traffic improvements necessary for truck traffic.
2018-2022	Traffic control and dam construction.

Table 2-1: Project Timeframe

Section 3 Traffic Analysis

Baseline of Existing Traffic

Existing Level of Service

Michael Baker International (Baker) performed a preliminary analysis of the existing level of service on SH 72 in order to determine how additional truck traffic on the highway would impact the level of service. Baker performed their level of service analysis by categorizing SH 72 as a Class II two-lane highway facility per the Highway Capacity Manual, and focusing on directional operational performance based on peak hour roadway segment volumes. For a Class II highway, level of service is defined in terms of percent time-spent following only. Based on the analysis Baker performed, the increases in truck traffic are expected to have very little impact on the percent time-spent following and do not change the level of service letter designation of SH 72 from the existing condition. HDR performed a peer review of the Baker analysis and found it to generally conform to the expectations of a conceptual level study. Refer to the appendix for the memo HDR completed based on their review of Baker's analysis.

Existing Traffic Volumes

Traffic counts were performed at the following intersections:

- SH 72 and Gross Dam Road
- SH 72 and Crescent Park Drive
- SH 72 and Skyline Drive
- Gross Dam Road and Crescent Park Drive
- SH 72 and Blue Mountain Road
- SH 72 and Plainview Road
- SH 72 and Twin Spruce Road

The counts were performed during the am peak period (9am to 11am) and the pm peak period (4pm to 6pm) on December 8, 2015 and December 9, 2015. At each intersection, turning movements on the main and minor roads and through movements on the main road were recorded. The intersection of SH 72 and Ranch Elsie Road was omitted from the traffic counts due to there being no safe location to count from. The peak hour was determined for each intersection by taking the sum of all traffic movements per 15 minute period and finding the greatest consecutive four 15 minute periods. Refer to Table 3-1 for an overview of the peak hour recorded at each intersection. Refer to the appendix for additional traffic data.

<table>
<tr><th>Intersection</th><th>AM/PM</th><th>Peak Hour</th></tr>
<tr><td rowspan="2">SH 72 and Gross Dam Road</td><td>AM</td><td>9:00-10:00</td></tr>
<tr><td>PM</td><td>4:00-5:00</td></tr>
<tr><td rowspan="2">SH 72 and Crescent Park Drive</td><td>AM</td><td>9:00-10:00</td></tr>
<tr><td>PM</td><td>4:15-5:15</td></tr>
<tr><td rowspan="2">SH 72 and Skyline Drive</td><td>AM</td><td>9:00-10:00</td></tr>
<tr><td>PM</td><td>4:15-5:15</td></tr>
<tr><td rowspan="2">Gross Dam Road and Crescent Park Drive</td><td>AM</td><td>9:30-10:30</td></tr>
<tr><td>PM</td><td>4:00-5:00</td></tr>
</table>

SH 72 and Blue Mountain Road	AM	9:00-10:00
	PM	4:45-5:45
SH 72 and Plainview Road	AM	9:00-10:00
	PM	4:45-5:45
SH 72 and Twin Spruce Road	AM	9:15-10:15
	PM	4:45-5:45

Table 3-1: Overview of Traffic Volumes

The following observations were made during traffic counts:

- SH 72 and Crescent Park Drive/Skyline Drive: The businesses around these intersections attracted many vehicles. In many instances, drivers drove to one of the businesses near these intersections, and then left in the same direction they arrived from and thus only passed through one of these intersections despite how close these intersections are.

Construction Traffic

Materials Hauling

This project will require importing cement and fly ash with bulk tractor trailer trucks via the SH 72 and Gross Dam Road Haul Route. It is anticipated that there will be anywhere from 30-40 truck trips per day based on a 5 day haul schedule. The schedule and duration for active trucking along the haul route is still under evaluation. The dam construction, which includes roller compacted concrete, requires sufficient cement and fly ash to be available for continuous construction. The intent of the ongoing hauling evaluation is to determine the ideal hauling time period that minimizes the number of trucks on the haul route while still meeting the demands for construction materials. This evaluation will determine if hauling can be completed in either a three day, four day, or five day work week. Regardless of the outcome of the hauling evaluation, the traffic control plan is the same for each option and focuses on general public awareness of the active haul route and other construction areas. Refer to the beginning of this section for information on how this traffic impacts the level of service of SH 72. Refer to the appendix for exhibits depicting the haul route.

Workforce Transportation

In addition to traffic generated from importing raw materials, there will also be traffic generated by a labor workforce that is required for the construction of the dam. A preliminary estimate of the required labor needed for the construction is in the neighborhood of 550,000 man-hours. Depending on the construction schedule and how the labor force is distributed, the labor force could consist of 75 workers on a day shift and the potential for 120 workers total, including day and night shifts. Refer to the beginning of this section for information on how this traffic impacts the level of service of SH 72.

Impacts Due to Construction Traffic

The construction traffic will increase the number of heavy duty trucks as well as passenger vehicles on SH 72 and Gross Dam Road; however, the level of service of SH 72 is unaffected by this increase in traffic as explained in the beginning of this section. It is anticipated that trucks will travel SH 72 without the need for one-way traffic areas or permanent roadway widening as SH 72 is a state owned highway designed, based on CDOT's minimum design standards, to accommodate certain heavy duty trucks which include the trucks expected to be used for this project. The largest impacts due to construction traffic will be along Gross Dam Road, where multiple flagging locations will control one-way traffic when trucks are present, and also at Gross Reservoir Access Road leading up to the dam, which will be closed to public access during the duration of construction. Slight impacts are expected along Flagstaff Road where a project parking lot, staging area, and lookout will be constructed and likely generate traffic beyond what is normal for this road.

Section 4 Traffic Control Measures

Basis of Design for Developing Traffic Measures

Traffic Signage Design

Traffic signage design was determined using the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, 2009 Edition including Revisions 1 and 2 dated May 2012. Refer to Table 4-1 for a reference on the sections of the MUTCD used for general guidance on the variable message and static signs explained later in this section. The MUTCD should be consulted for final design prior to installation of any signs as Table 4-1 does not constitute a complete list of MUTCD sections to follow.

Sign	MUTCD Sign Code	MUTCD Section
Permanent and Portable Variable Message	N/A	Sections 2L.01, 2L.04, 2L.05, 6F.60
Flagger Symbol	W20-7	Sections 6C.04 , 6F.31
500 Feet (Distance) Plaque	W16-2P	Sections 2C.55, 6C.04
Be Prepared to Stop	W3-4	Sections 2C.36, 6C.04
Signal Ahead	W3-3	Sections 2C.36, 6C.04
Road Closed	R11-2	Sections 2B.58, 6F.08
Work Zone	W20-Special	N/A
Next X.X Miles (Distance) Plaque	W7-3aP	Sections 2C.55, 6F.53
Truck	W11-10	Sections 2C.49, 6F.36
Bicycle	W11-1	Section 2C.49
Share the Road Plaque	W16-1P	Section 2C.60

Table 4-1: Overview of MUTCD Sections Used for Sign Design

Curve Flagging and Vehicle Queue Hold Locations

Curve flagging and vehicle queue hold locations are locations where only one-way traffic will be permitted during active hauling hours when trucks are present. These locations were determined using the CAD computer program AutoTURN. The design vehicle used was the AASHTO 2004 WB-50 Truck, which is the agreed upon vehicle that most closely represents the trucks likely to perform the hauling. The generate arc and corner path AutoTURN tools were used to generate the driving path of the truck along Gross Dam Road and Gross Reservoir Access Road.

It is standard practice that the design speed of a roadway is 5-10 mph above the posted speed limit. The posted speed of Gross Dam Road is 20 mph and there is no posted speed on Gross Reservoir Access Road. The tight curves along Gross Dam Road were first reviewed with AutoTURN at 25 mph in attempting to keep with standard practice design speeds. This speed was quickly ruled out as unfeasible due to the impactful improvements required to allow for a 25 mph speed along a tight curve. See Figure 4-1.

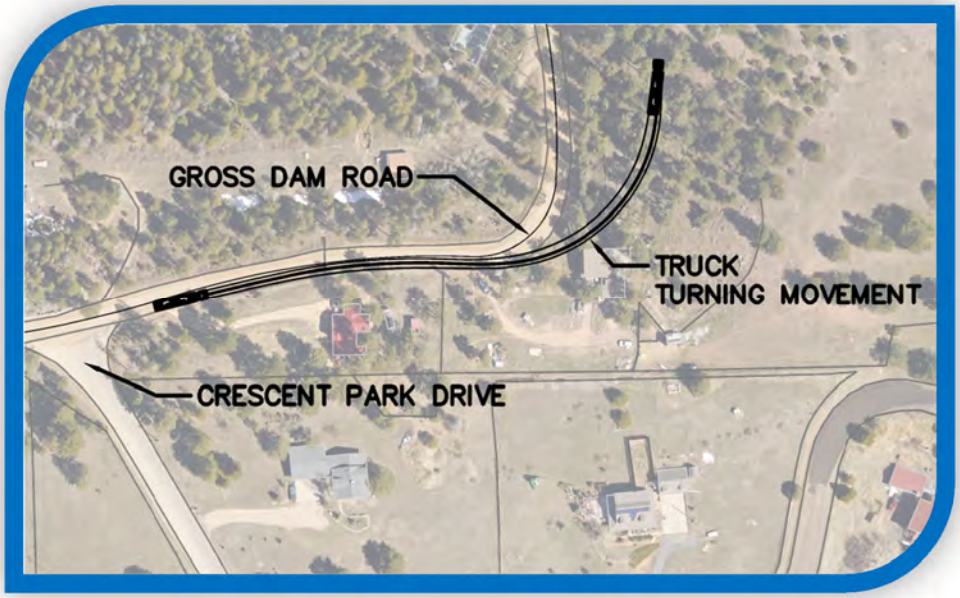

Figure 4-1: 25 mph WB-50 Turning Movement on a Tight Curve

Gross Dam Road and Gross Reservoir Access Road were then reviewed with AutoTURN at a 20 mph speed. Two-way truck traffic was reviewed to determine if the trucks could pass without overlapping driving paths and without going outside of the roadway. Anytime one of these scenarios was encountered, the curve was marked as a curve requiring one-way travel with truck traffic present. See Figure 4-2.

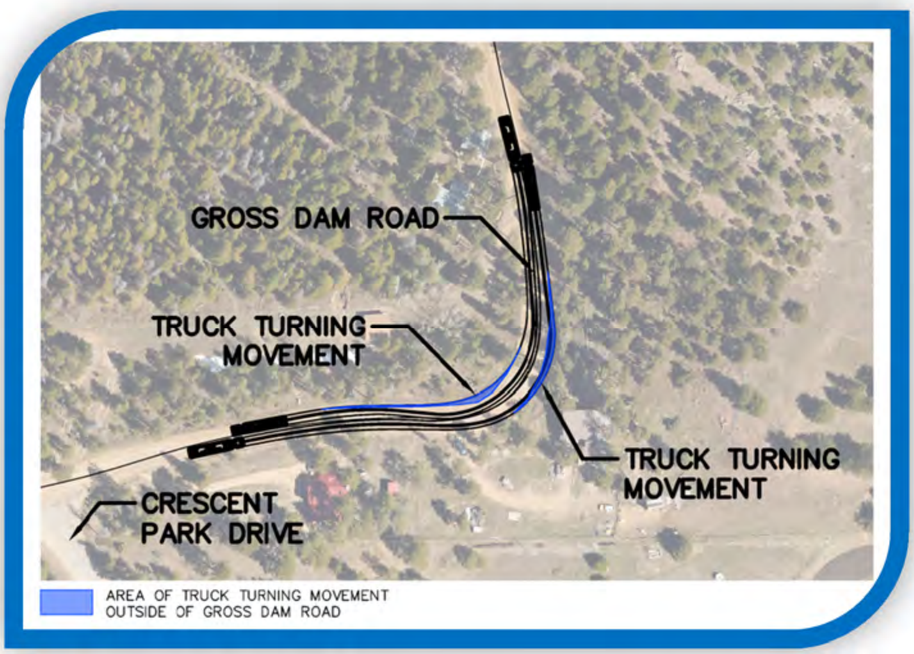

Figure 4-2: WB-50 Turning Movement Outside of Gross Dam Road

The final AutoTURN check performed was to ensure the trucks could navigate the tightest curves at 20 mph or 15 mph with one-way traffic. See Figure 4-3. The tightest curves along Gross Dam Road and Gross Reservoir Access Road are only possible at 15 mph with one-way traffic. It is assumed at these curves that the truck drivers, being professional drivers, will navigate them safely and thus no widening is required to allow for 20 mph speed travel.

Figure 4-3: Tight Curve with One-Way Traffic Example

Work Zone Location

The work zone location is a location that provides warning to roadway users about the presence of additional construction traffic. This location was determined based upon a Denver Water identified project parking lot, staging area, and lookout location. This location needs to be finalized; however, the signage design generally applies regardless of the exact location of the parking lot, staging area, and lookout.

SH 72 and Gross Dam Road Intersection

Improvements at the intersection of SH 72 and Gross Dam Road are needed to allow for truck traffic into and out of Gross Dam Road. These improvements were determined using the CAD computer program AutoTURN. The design vehicle used was the AASHTO 2004 WB-50 Truck, which is the agreed upon vehicle that most closely represents the trucks likely to perform the hauling. The generate arc and corner path AutoTURN tools were used to generate the driving path of the truck along Gross Dam Road and Gross Reservoir Access Road.

The driving speed used at the intersection was 5 mph, and it's standard practice to use a speed under 10 mph for intersection turns. The turning movements were laid out for one-way truck traffic in order to avoid impacts to nearby private property. Flaggers are proposed at the intersection to control one-way traffic when trucks are present. Improvements at the intersection are based on the one-way truck traffic driving paths.

Traffic Control Devices

Striping

It is recommended that a technical specification to address the safety of the haul route be incorporated into the construction contract. The contractor selected for dam construction should be required to adhere to a traffic control plan which will require traffic control devices and maintenance of these devices, including the striping along SH 72. This will ensure all the devices along SH 72 and Gross Dam Road are maintained during hauling, which contributes to improved safety along the haul route.

Signing

Variable Message Signing

Three variable message signs are proposed along SH 72 and Gross Dam Road; two permanent and one portable sign. The permanent signs will be controlled by Denver Water during the duration of Gross Dam Reservoir Construction, and will either be turned over to CDOT Ownership at the completion of construction or removed. The portable sign will be the responsibility of the contractor to provide and maintain throughout the duration of construction and will remain under the ownership of the contractor and removed at the end of construction. The suggested messages for the proposed permanent and portable signs are two-phased messages, which means one message shows on the screen, then a second message shows on the screen, and then the messages repeat in the same order.

A permanent variable message sign is proposed on SH 72 close to the intersection of SH 72 and SH 93 to warn drivers of the beginning of the westbound haul route. The suggested message at this location is: HEAVY TRUCK TRAFFIC SH 93 TO GROSS DAM ROAD. USE CAUTION.

A second permanent variable message sign is proposed on SH 72 close to the intersection of SH 72 and Gross Dam Road to warn drivers of the beginning of the eastbound haul route. The suggested message at this location is: HEAVY TRUCK TRAFFIC GROSS DAM ROAD TO SH 93. USE CAUTION.

A portable variable message sign is proposed on Gross Dam Road close to the intersection of SH 72 and Gross Dam Road to inform drivers headed northbound of flagging operations along Gross Dam Road. The suggested message at this location is: FLAGGERS NEXT 4 MILES. EXPECT DELAYS.

The variable message sign messages are suggested at this time. Denver Water, CDOT, and Boulder and Jefferson Counties will have the ability to change and repurpose these permanent variable message signs as needed for the community. These messages can be changed to other safety messages that may need to be conveyed to the traveling public.

It is typical and recommended that the contractor maintains responsibility of the messages on these variable message signs and ensures the messages are only displayed when appropriate. Appropriate times include during active hauling hours, during hours with active construction traffic, or other scenarios as they arise.

For a graphical view of these signs, including their suggested locations and messages, refer to the appendix. For a tabulation of these signs, refer also to the appendix.

Static Construction Signing

Multiple static construction signs are proposed along SH 72, Gross Dam Road, Gross Reservoir Access Road, and Flagstaff Road. Some signs are proposed to remain once Gross Dam Reservoir Construction is completed and some signs are proposed to be removed. For the temporary signs, these can either be constructed on permanent posts or temporary posts. The recommendation is to construct signs along SH 72 on permanent posts and signs along Gross Dam Road, Gross Reservoir Access Road, and Flagstaff Road on temporary posts.

Gross Dam Road, Gross Reservoir Access Road, and Flagstaff Road Static Signs

The static signs on Gross Dam Road, Gross Reservoir Access Road, and Flagstaff Road serve to inform and warn drivers about upcoming flaggers/vehicle queue holds, to inform drivers of road closure locations, and to inform and warn drivers about areas with increased construction traffic.

Four curve flagging zones are proposed along Gross Dam Road and Gross Reservoir Access Road. Each flagging location is preceded by a flagger symbol sign with a distance plaque and a “be prepared to stop” sign.

One vehicle queue hold location is proposed along Gross Reservoir Access Road and Flagstaff Road. The begin/end points of the vehicle queue hold are preceded by either a flagger symbol sign with a distance plaque if a flagger is used or a signal ahead sign if a signal is used, and a “be prepared to stop” sign.

Gross Reservoir Access Road will become part of the active construction zone at the Denver Water Headquarters Building, and for safety reasons, access to this road beyond the headquarters building will be closed to all traffic except for construction traffic. To control access to the active construction area, Denver Water will have a security guard house on Gross Reservoir Access Road at the headquarters building. In addition, a road closed sign will be placed near the proposed security guard shack to alert and control non construction traffic heading towards the dam.

Construction traffic warning signs are proposed along Flagstaff Road near the Denver Water Headquarters Building and near the proposed project parking lot, staging area, and lookout location. A work zone sign with a distance plaque is proposed at the begin/end points of this area of additional construction traffic. An end work zone sign is proposed on the north end of Flagstaff Road where drivers can expect the roads to be free of hauling and general construction traffic. Truck signs are proposed on either side of the proposed project driveway to the parking lot, staging area, and lookout location, warning drivers of the potential entry into the roadway by vehicles.

The signs discussed for Gross Dam Road, Gross Reservoir Access Road, and Flagstaff Road will be temporary and the responsibility of the contractor’s to obtain, and will remain under the ownership of the contractor and removed at the end of construction. The signs will also only be visible during active flagging hours and during active construction traffic hours. It will be the responsibility of the contractor’s to remove or cover the view of these signs to drivers outside of active flagging/construction traffic hours.

SH 72 Static Warning Signs

The static warning signs on SH 72 will serve to inform drivers about truck traffic as they travel on SH 72 and at locations where drivers are about to enter SH 72. They will also serve to inform drivers about the possible presence of bicyclists on the road. Flashing beacons will also be mounted to all of the static warning signs on SH 72. The intent of the flashing beacons is to add attention grabbing flashing lights so that the traveling public does not develop sign immunity.

Bicycle signs with share the road plaques and flashing beacons are proposed at four locations along SH 72 in both the eastbound and westbound directions. The signs are proposed at relatively evenly spaced distances between SH 93 and Gross Dam Road. A bicycle sign with a share the road plaque exists on SH 72 in the westbound direction just after the intersection with Crescent Park Drive. It is proposed to add a flashing beacon to the existing sign and plaque. These signs will be permanent signs that will be turned over to CDOT at the completion of construction.

Truck signs with flashing beacons are proposed at major intersections with SH 72 and at business locations along SH 72. These signs will be temporary and the responsibility of the contractor’s to obtain, and will remain under the ownership of the contractor and removed at the end of construction.

Truck signs with distance plaques and flashing beacons are proposed at four locations along SH 72 in both the eastbound and westbound directions. These signs are proposed at relatively evenly spaced distances between SH 93 and Gross Dam Road. These signs will be temporary and the responsibility of the contractor's to obtain, and will remain under the ownership of the contractor and removed at the end of construction.

The proposed flashing beacons will only operate during haul route hours. It will be the contractor's responsibility to turn these beacons on and off.

The temporary signs will only be visible during active hauling hours. It will be the responsibility of the contractor's to obstruct the view of these signs to drivers outside of active hauling hours. The method of obstruction is typically left up to the contractor.

Static Signs at the Intersection of SH 72 and Gross Dam Road

The static signs at this intersection serve to inform and warn drivers about upcoming flaggers. Each flagging location is preceded by a flagger symbol sign with a distance plaque and a "be prepared to stop" sign. Two flagger symbol signs are also proposed along private driveways to warn residents about the possibility of stopping as they approach the intersection. These signs will be temporary and the responsibility of the contractor's to obtain, and will remain under the ownership of the contractor and removed at the end of construction.

The signs will only be visible during active flagging hours. It will be the responsibility of the contractor's to obstruct the view of these signs to drivers outside of active flagging hours. The method of obstruction is typically left up to the contractor.

For a graphical view of the static construction signs, including their suggested locations, refer to the appendix. For a tabulation of these signs, refer also to the appendix.

Traffic Control Flagging

There are four curve flagging zones proposed along Gross Dam Road and Gross Reservoir Access Road. Each flagging zone will consist of the signage discussed earlier in this section and one or more flaggers. The flagger(s) will watch for approaching truck traffic and stop travel in one direction if a truck(s) is present to allow the truck(s) to safely traverse tight roadway curvature. Once the truck(s) has cleared the flagging zone, stopped traffic will be permitted to proceed. Two-way traffic will be maintained within these flagging zones while a truck(s) is not present. Traffic delays will be encountered at each flagging zone when trucks are present. Included in the appendix is a summary of estimated traffic delays at each individual flagging zone. The delays will be minimized to the extent possible, but safety at these locations must be a priority.

Flaggers will be needed at driveways and intersections within flagging zones to ensure the safety of drivers entering Gross Dam Road or Gross Reservoir Access Road. Flaggers will permit traffic to enter the flagging zone when it is safe to do so; namely, when truck traffic is not present traveling in the direction opposite of which the drivers need to travel. As traffic plans are finalized, Denver Water and the dam contractor may have the opportunity to reach out to individual owners to minimize the need for a flagger at each driveway by placing alternate devices at the driveways, such as mirrors, that will allow the drivers to see through the flagging zone.

Traffic Control Supervisor

It is recommended that Denver Water require the contractor to provide a Traffic Control Supervisor (TCS). The TCS will be the person responsible for maintaining and supervising all the traffic control measures during construction of the project. Duties of the TCS will include ensuring flashing beacons are turned on and off as appropriate, that variable message signs are displaying the appropriate messages and are on and off as appropriate, and that construction signs are displayed as appropriate for the haul activities. The TCS will also be responsible for ensuring the traffic control devices are in good condition, or if not, to ensure they're repaired or replaced in a timely manner. Finally, the TCS will coordinate with the public involvement officer to keep the public informed about the traffic control measures in place and what changes are made if any. CDOT has project special provisions that are commonly used for construction projects which outline the role and responsibility of the TCS, and it is recommended a similar specification be included in the final project.

Section 5 Road Maintenance

Roadway Surface Condition

The existing surfacing along the haul route is mixed. SH 72's travel lanes and shoulders are paved with asphalt, while Gross Dam Road is surfaced with aggregate base course or a gravel surface. Denver Water discussed SH 72's surfacing with CDOT, and these discussions resulted in an agreement that the existing pavement is designed for legal truck loading, and legal truck loading will be used in hauling the raw materials for this project. The pavement type on SH 72 is common for state highways within mountainous canyons and has a proven history of handling truck traffic. Gross Dam Road is a low volume road that has not been subjected to long periods of truck traffic. Denver Water discussed Gross Dam Road's surfacing with Boulder County, and while no specific agreement has been reached, Denver Water will continue to discuss the project needs with the county. The gravel surface will require maintenance to avoid potholing and the washboard effect that may be caused by additional truck traffic.

It is recommended that Denver Water include in the final project a project specification that requires the selected dam expansion contractor to provide maintenance along both Gross Dam Road and SH 72. This project specification should include maintenance requirements that require safe roadway surfacing conditions to be maintained that are free of potholes and washboard effects, and have smooth shoulders.

Dust

Boulder County Public Health follows the Colorado Air Quality Control Commission's Regulation No.1. This regulation states that every owner or operator of an activity that creates fugitive dust must use all practical measures or operating procedures necessary to minimize fugitive dust. Denver Water will coordinate and work with Boulder County to provide dust mitigation along Gross Dam Road. Potential dust mitigation measures include the following:

- Watering the roadway.
- Applying chemical dust suppressants such as magnesium chloride to the roadway.
- Covering haul trucks or leaving sufficient freeboard so dust won't fly out of haul trucks.
- Covering or watering stockpiles.
- Washing off tires as they move from an unpaved to a paved road.
- Suspending hauling activities when there are high wind speeds.

Transportation Hotline

It is recommended that Denver Water establish a transportation hotline number for residents and the traveling public. The hotline will provide an opportunity for residents and the traveling public to report any deficiencies in the roadway surfacing, dust conditions, or the traffic control devices. The transportation hotline should be staffed by the Dam Contractor, and Denver Water should require the contractor to submit a written plan of anticipated issues and associated resolutions. The written plan should include how each issue is recorded, documented, resolved, and reported. Denver Water should monitor the reports and ensure that public concerns are being addressed to their satisfaction.

APPENDIX

HDR Peer Review Memo

Memo

Date:	October 13, 2015
Project:	Gross Reservoir Dam Expansion
To:	Alliant Engineering
From:	HDR Engineering
Subject:	Peer Review of Concept Study for Gross Reservoir Dam Expansion Alternatives Analysis and Feasibility Study for Roadway Improvements

Scope and Purpose of Peer Review

HDR was contracted by Alliant Engineering to conduct a peer review of the June 30, 2014, A*lternatives Analysis and Feasibility Study* (2014 study) prepared by Michael Baker. The purpose of this peer review was to evaluate and determine the validity of the analysis on the Level of Service (LOS) determination on SH 72, and to identify where adjustments may be needed to develop a more complete and compressive report commensurate with the requirements of a traffic report required for a CDOT Access Permit. This peer review was also performed to confirm that bikable shoulders on SH 72 are not feasible. The purpose of the traffic report included in the project scope will be to further develop and refine the methodologies, data collection techniques, and assumptions made in the 2014 study.

Data Collection

There was no discussion regarding the collection of data for the 2014 study apart from the Mock Haul Study. Missing discussion included how the traffic data were obtained, such as with turning movement counts or automatic tube counts. Hence, the source of Average Daily Traffic (ADT) listed in Table 1 and the year the data were collected are unclear. Since this information forms the basis for traffic analysis, a data source reference or calculations that refer to the ADT volumes should have been provided.

Based upon this review, and assuming the number of trucks on the SH 72 corridor remained the same, a decrease in ADT should have resulted in higher truck percentages. However, Table 1 showed an increase in truck percentage followed by a decrease, between mile markers 10.66 and 20.73. During the development of the final study, the truck volumes and percentage calculations should be verified.

Duration of Construction

There was no discussion about the duration of construction in the 2014 study. Including a time estimate of the extent of Scenarios 1 and 2 would help better gauge the impacts to traffic. This will help in determining a need to grow the traffic volumes to a future year to reflect the affected traffic conditions more accurately.

Study Area

Though the haul route was described in Section I, the division of SH 72 corridor into mile markers listed in Tables 4, 5, and 6 was not described in the 2014 study. The reasoning for breaking the

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corridor into sections should have been better described. Reasons include breaking up the corridor to determine the LOS based upon uphill grade adjustments, which are generally included in areas of changing terrain such as the SH 72 corridor. In addition to a two-lane highway analysis, an intersection analysis for the intersections along SH 72 corridor may need to be considered for evaluating the impacts caused to general traffic in the area.

Existing Peak Hour Volumes

As described in Section III of the 2014 study, the peak hour volumes used for peak period analysis were calculated using the peak hour factors and distribution factors. However, how those factors were derived was not described. In addition there was no mention of the K-factor which is typically used in such calculations.

A closer review of the existing peak period volumes used in the traffic analysis indicate that there is a significant increase (25% to 40%) in eastbound direction between mile markers 18.6 and 10.7; and an increase (75%) followed by large drop (30%) in the westbound direction, during the AM peak hour. Because of the use of directional factor while deriving peak hour volumes, these patterns appear to occur in reverse during the PM peak hour. The figures attached to this memo present the peak hour volumes used in the analysis by direction, peak hour, and condition (Existing/Scenario 1/Scenario 2). Based upon the anomalies noted, the existing traffic should be evaluated to verify the data provided in the 2014 study.

Because the streets intersecting this section of SH 72 are not expected to generate or consume heavy traffic, the increase or decrease in volumes is considered very significant. Therefore, it is recommended that turning movement counts are collected for the two peak periods to estimate hourly traffic activity along SH 72. The following intersections should be considered for turning movement counts:

- SH 72 and Gross Dam Road
- SH 72 and Ranch Elsie Road
- SH 72 and Crescent Park Drive
- SH 72 and Skyline Drive
- SH 72 and Twin Spruce Road
- SH 72 and Blue Mountain Road and
- SH 72 and Plainview Road

Future Peak Hour Volumes

The daily truck volumes anticipated during Scenarios 1 and 2 are 88 and 240, respectively. The distribution of these volumes during peak hours was not described in the 2014 study. An estimate of construction schedule or previous similar construction schedules should be used to estimate the number of truck trips during peak hours. This will provide a more accurate estimate of truck activity impacts during each construction scenario.

Study Methodology

To conduct the peak period analysis, an outdated version of Highway Capacity Software (HCS+) was used for the 2014 study. This version was based on Highway Capacity Manual (HCM 2000).

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The latest version of HCS (ver 2010) developed based on HCM 2010 will be used for future traffic analysis.

Scenario Evaluation

In addition to LOS measure, the travel time measurement will be considered for evaluating the scenarios and comparing with the existing travel times collected during Mock Haul Study.

Findings of the Peer Review

Based upon the summary of observations, there are methodologies and assumption that need to be refined. However, the results of the peer review found the 2014 *Alternatives Analysis and Feasibility Study* to generally conform to the expectations of a conceptual level study.

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Traffic Count Data

Intersection:	SH 72 and Gross Dam Road

Time Increment	SH 72						Gross Dam/Community Center Drive						Total
	Left WB	Through WB	Right WB	Left EB	Through EB	Right EB	Left SB	Through SB	Right SB	Left NB	Through NB	Right NB	
9-9:15	1	14	0	2	30	0	0	0	2	0	0	0	49
9:15-9:30	0	12	0	2	26	1	1	0	0	0	0	0	42
9:30-9:45	0	12	0	0	11	0	0	0	0	0	0	0	23
9:45-10	0	14	0	1	20	0	1	0	1	0	0	0	37
10-10:15	0	10	2	0	15	0	3	0	1	0	0	0	31
10:15-10:30	0	11	0	0	9	0	0	0	0	0	0	0	20
10:30-10:45	0	12	1	2	12	0	1	0	2	1	0	1	32
10:45-11	0	10	0	1	14	0	1	0	1	0	0	0	27

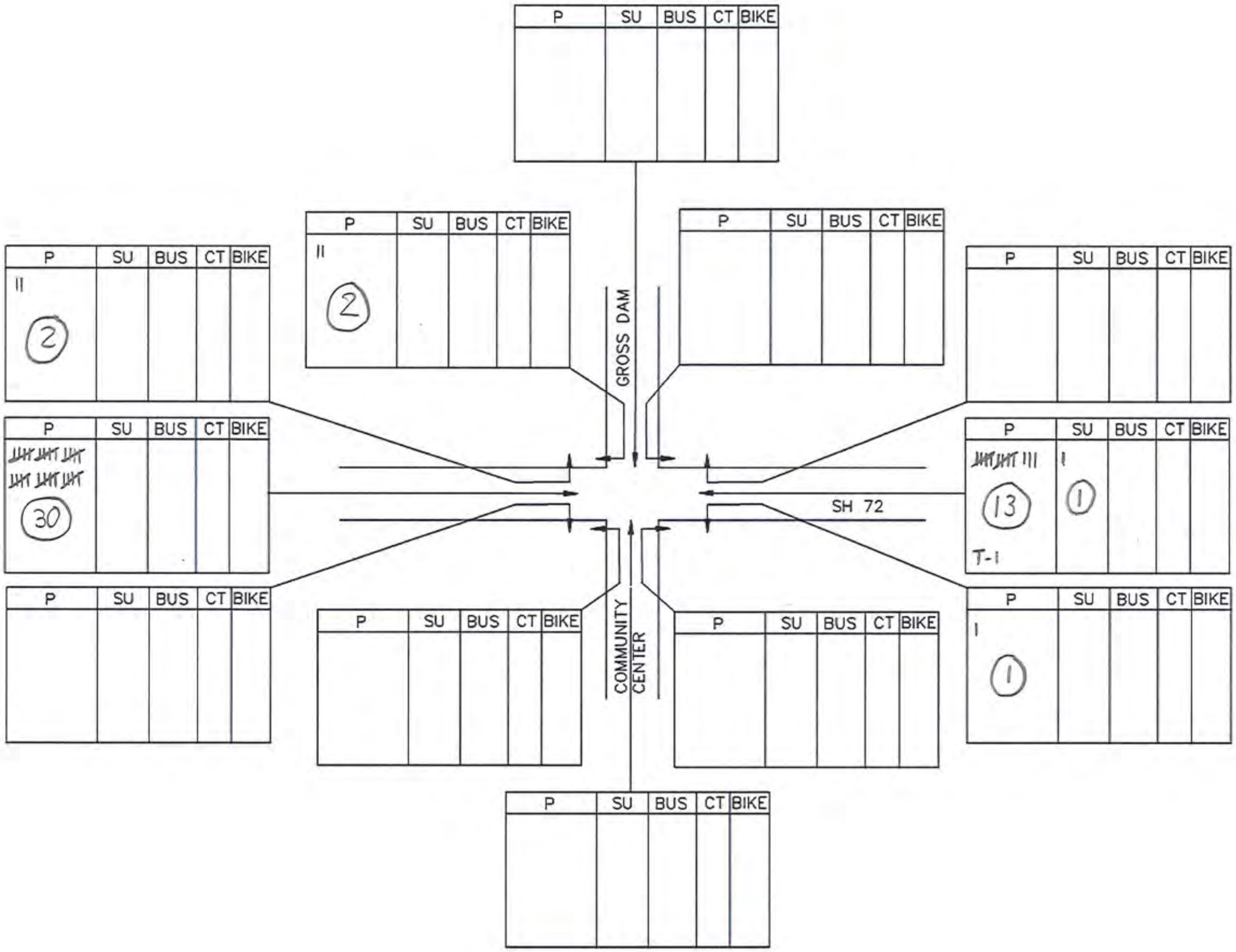
Time Increment	SH 72						Gross Dam/Community Center Drive						Total
	Left WB	Through WB	Right WB	Left EB	Through EB	Right EB	Left SB	Through SB	Right SB	Left NB	Through NB	Right NB	
4-4:15	0	34	2	1	18	0	6	0	3	0	0	0	64
4:15-4:30	0	48	2	3	23	0	2	0	1	0	0	0	79
4:30-4:45	0	47	1	1	18	0	0	0	1	0	0	0	68
4:45-5	0	39	1	1	8	0	0	0	1	0	0	0	50
5-5:15	0	41	1	0	15	0	1	0	1	0	0	0	59
5:15-5:30	0	32	1	1	15	0	3	0	0	0	0	0	52
5:30-5:45	0	34	1	0	12	0	4	0	1	0	0	0	52
5:45-6	0	43	0	0	14	0	0	0	0	0	0	0	57

Indicates peak hour

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:00am to 9:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

9:00 - 9:15

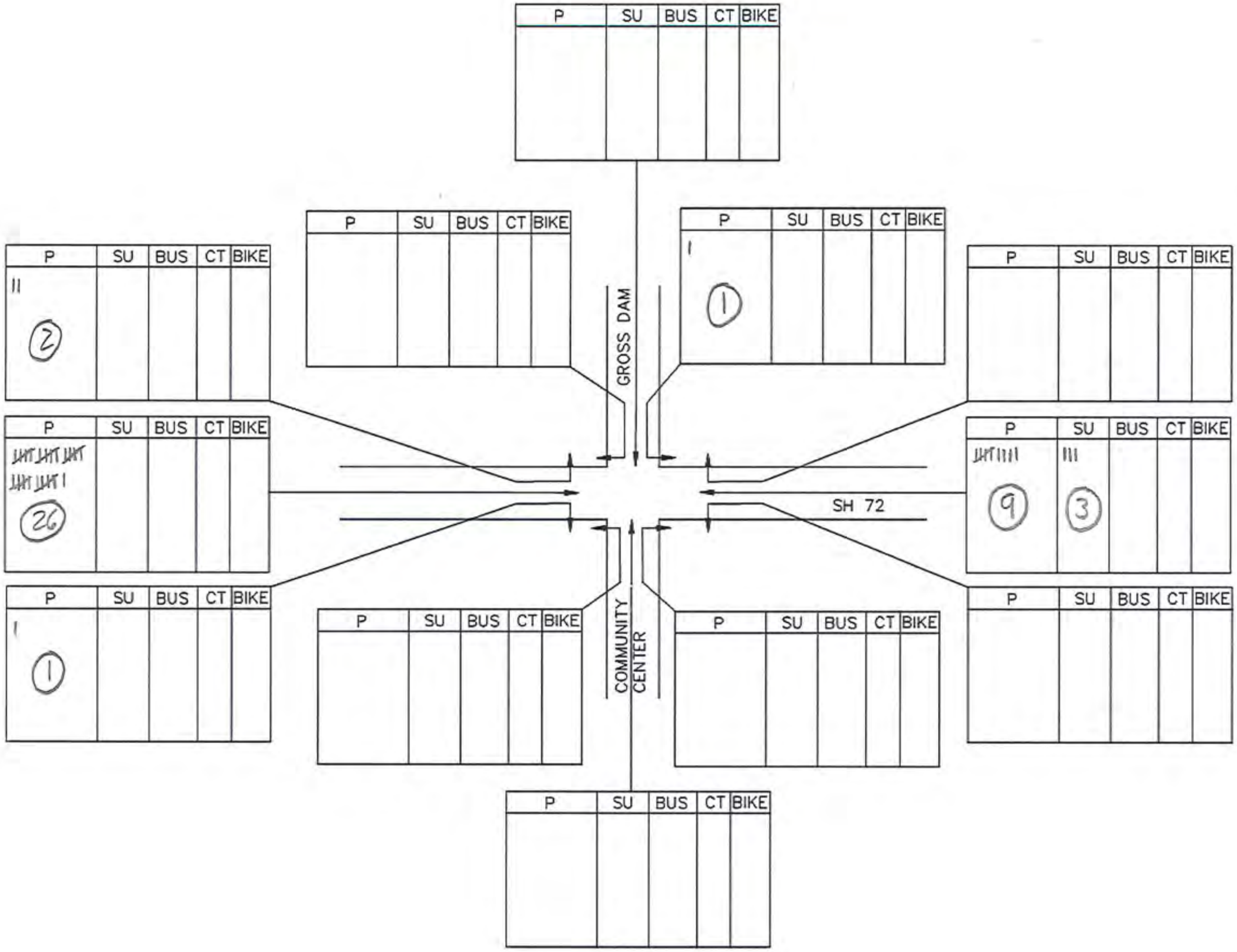


* Trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:15am to 9:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

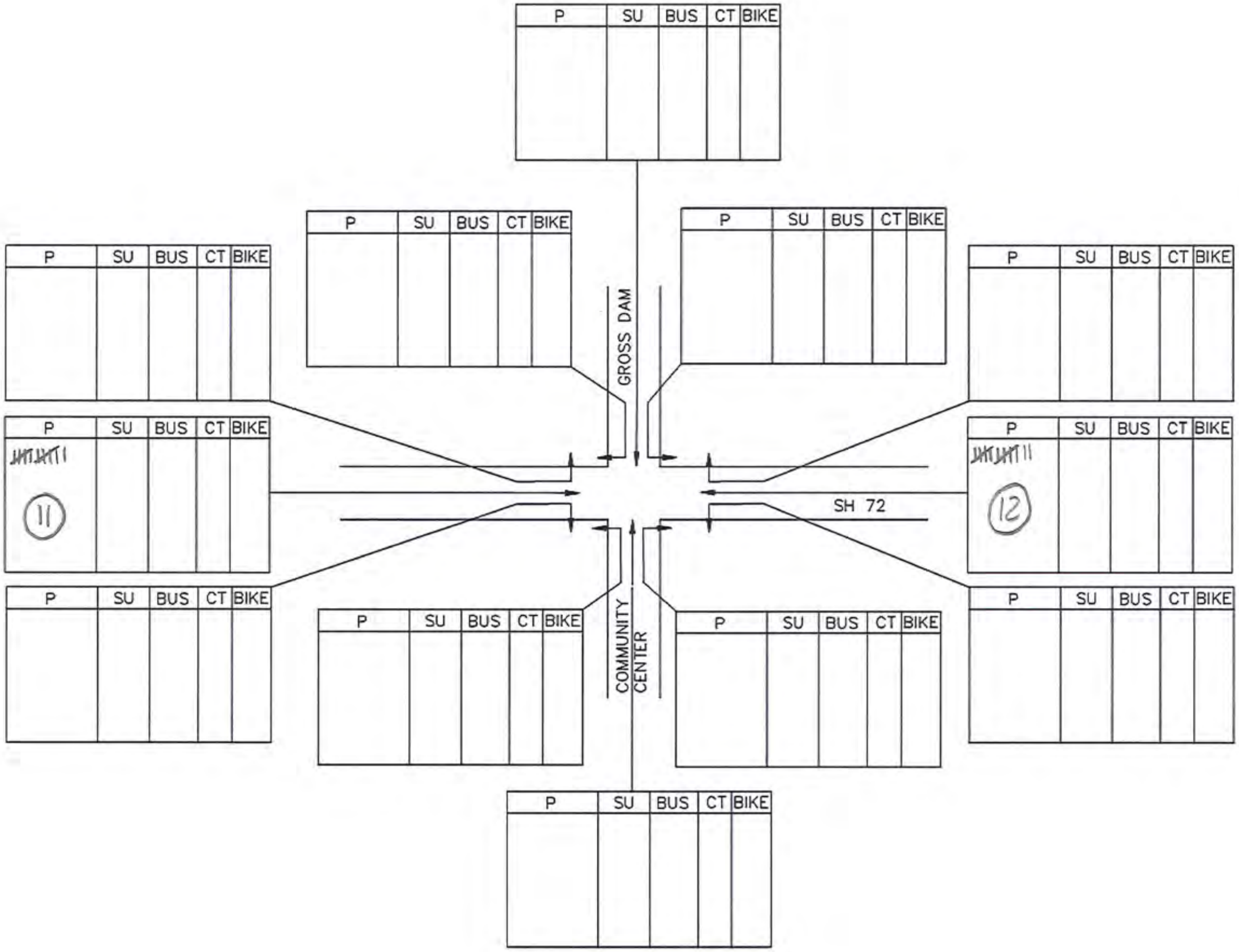
9:15-9:30


GROSS DAM
COMMUNITY CENTER
SH 72
P
SU
BUS
CT
BIKE
II
2
1
1
26
1
9
3
IIII IIII III IIII IIII I
IIII IIII
III

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:30am to 9:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

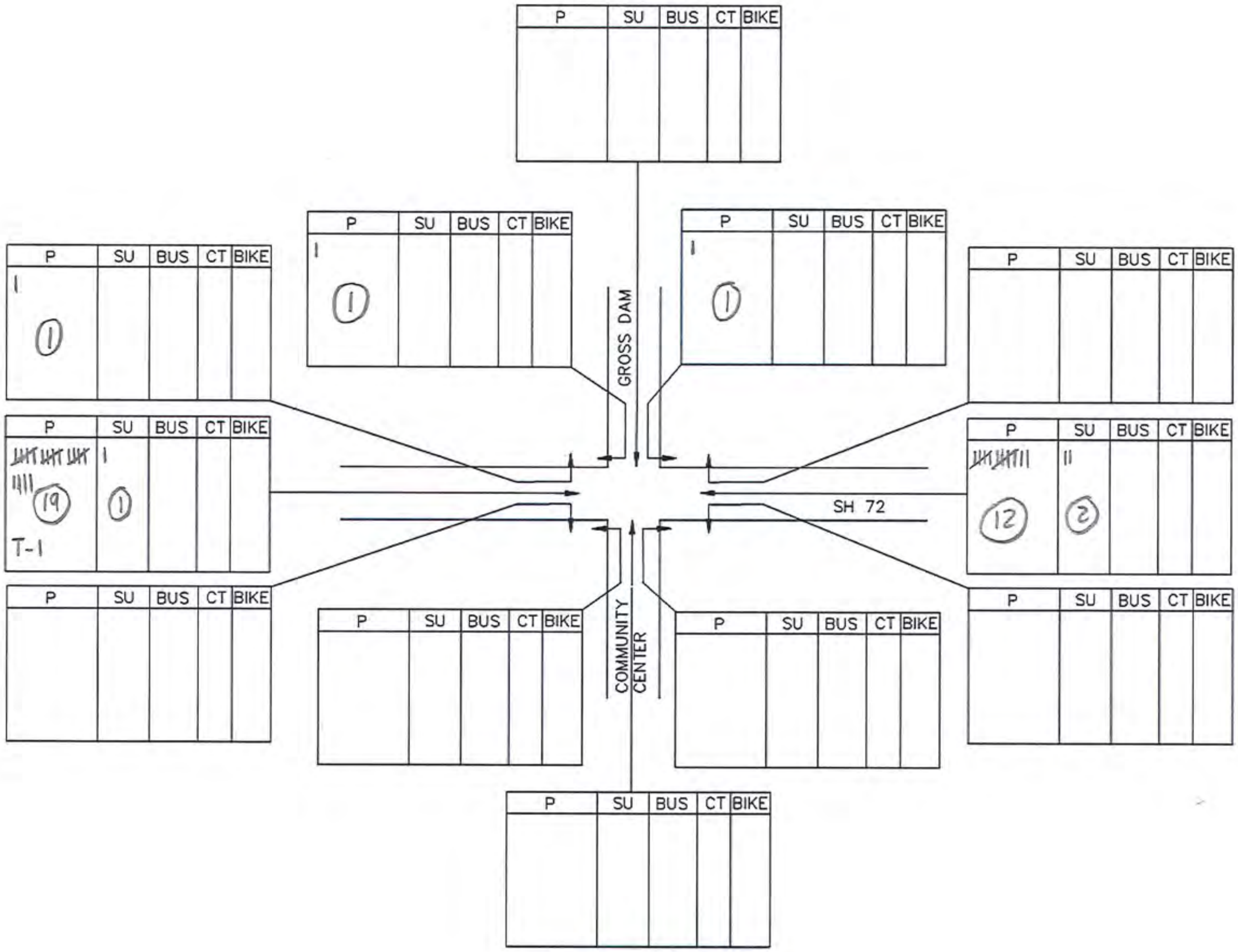
9:30 - 9:45



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:45am to 10:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

9:45 - 10:00

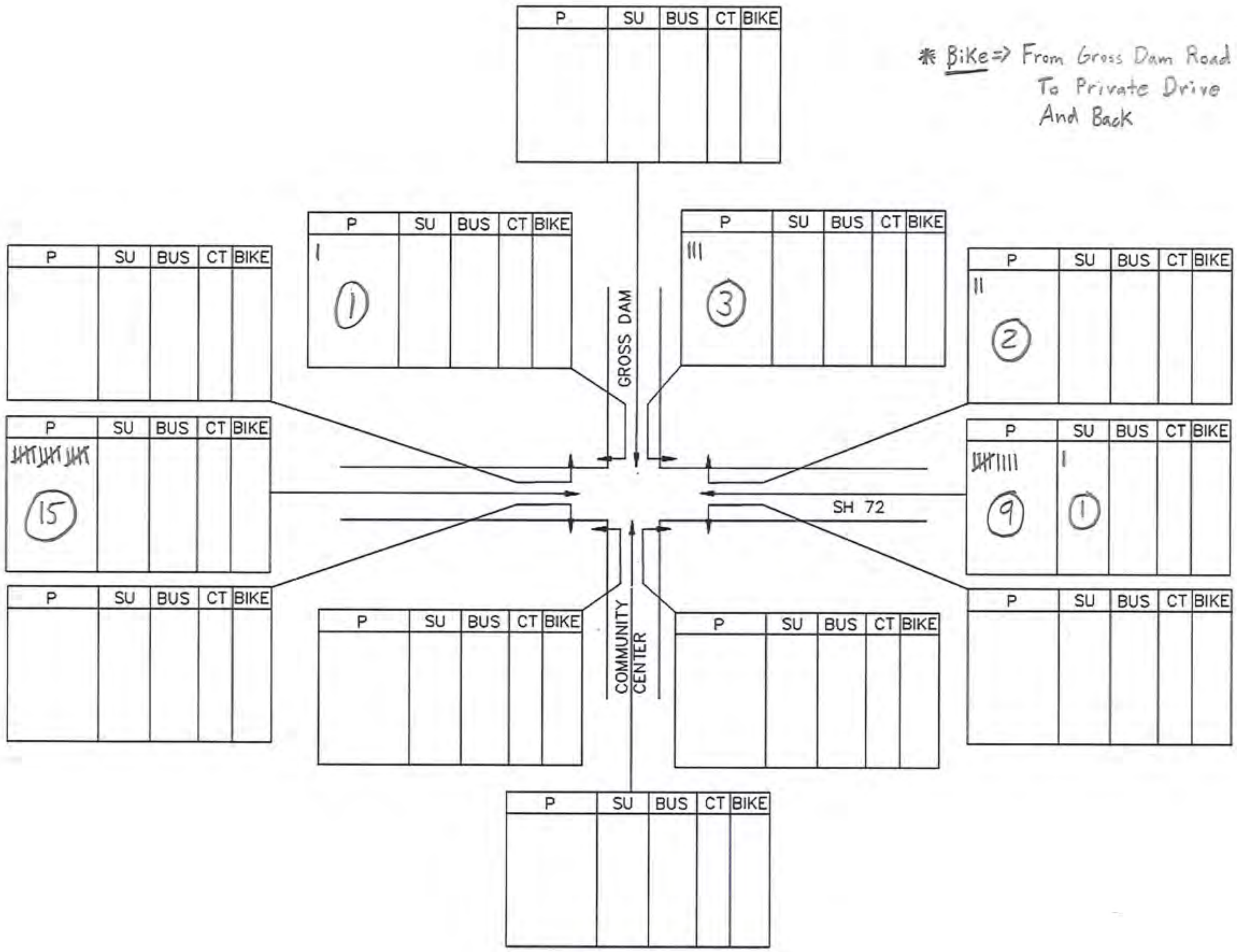


* Trailer ticks indicate the number of vehicles under the vehicle column with trailers and one double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:00am to 10:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:00 - 10:15



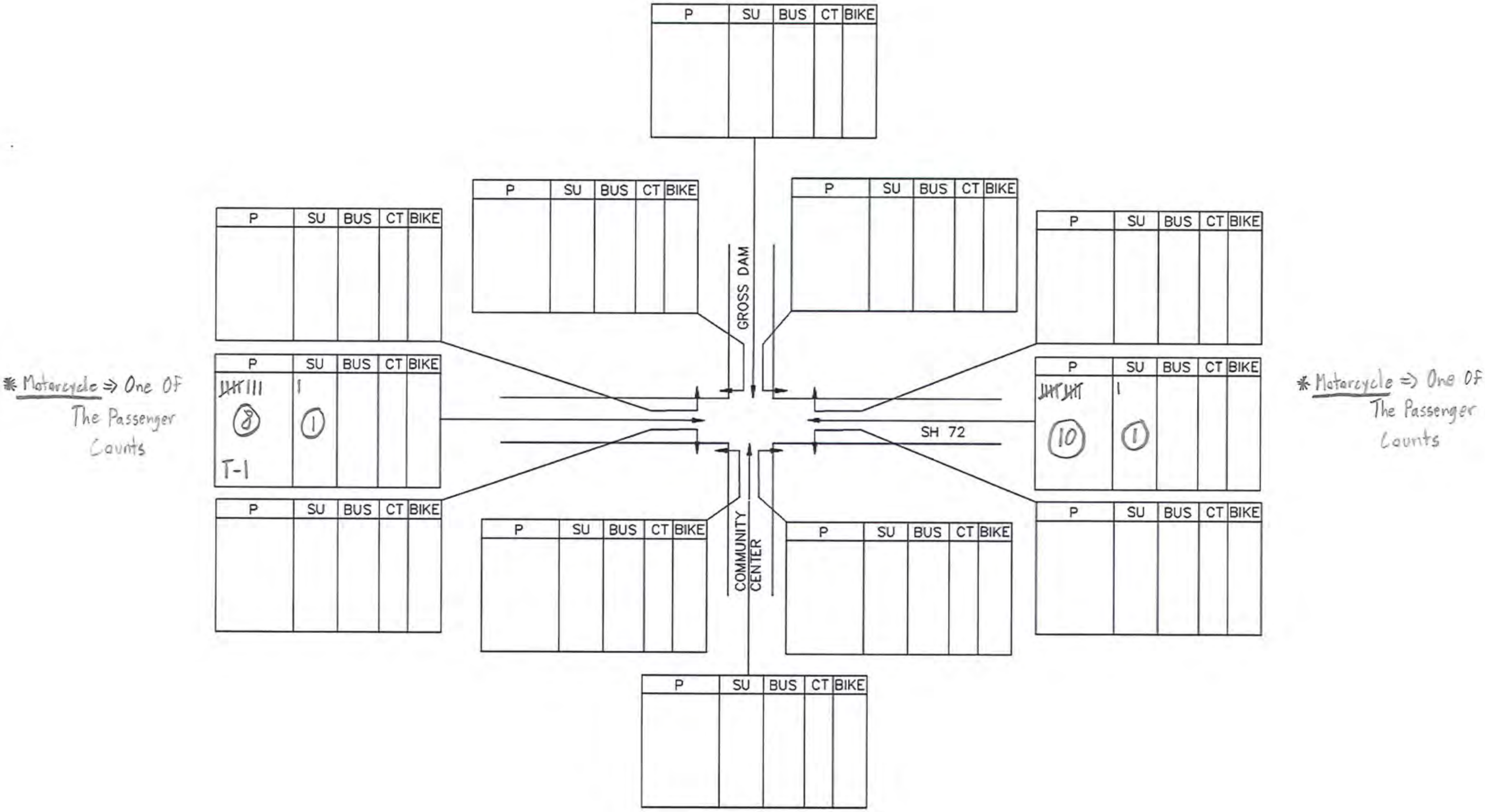
* Bike => From Gross Dam Road To Private Drive And Back

* Motorcycle => One Of The Passenger Counts

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:15am to 10:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:15 - 10:30

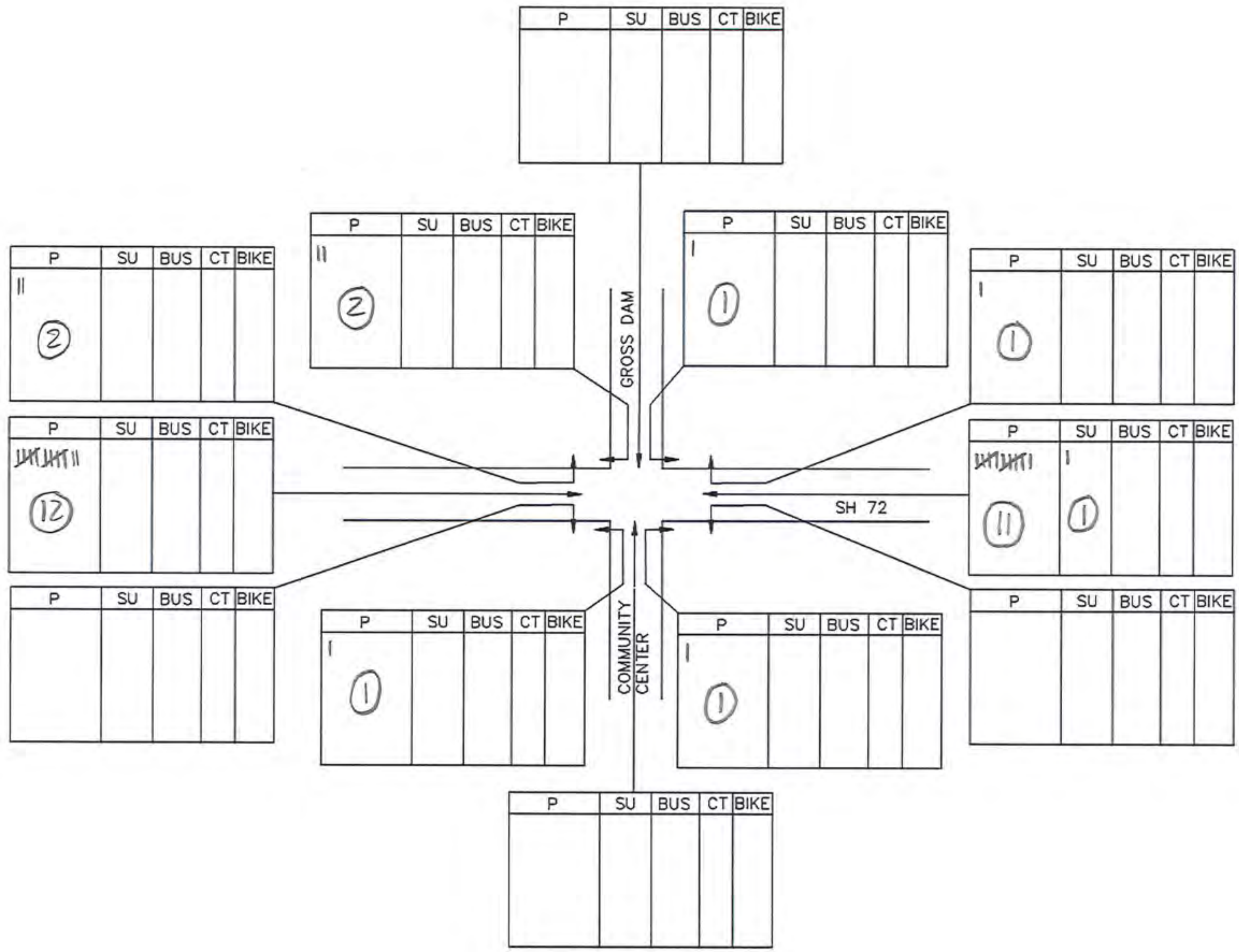


* Trailer ticks, indicate the number of vehicles under the vehicle column w/ trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:30am to 10:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:30 - 10:45



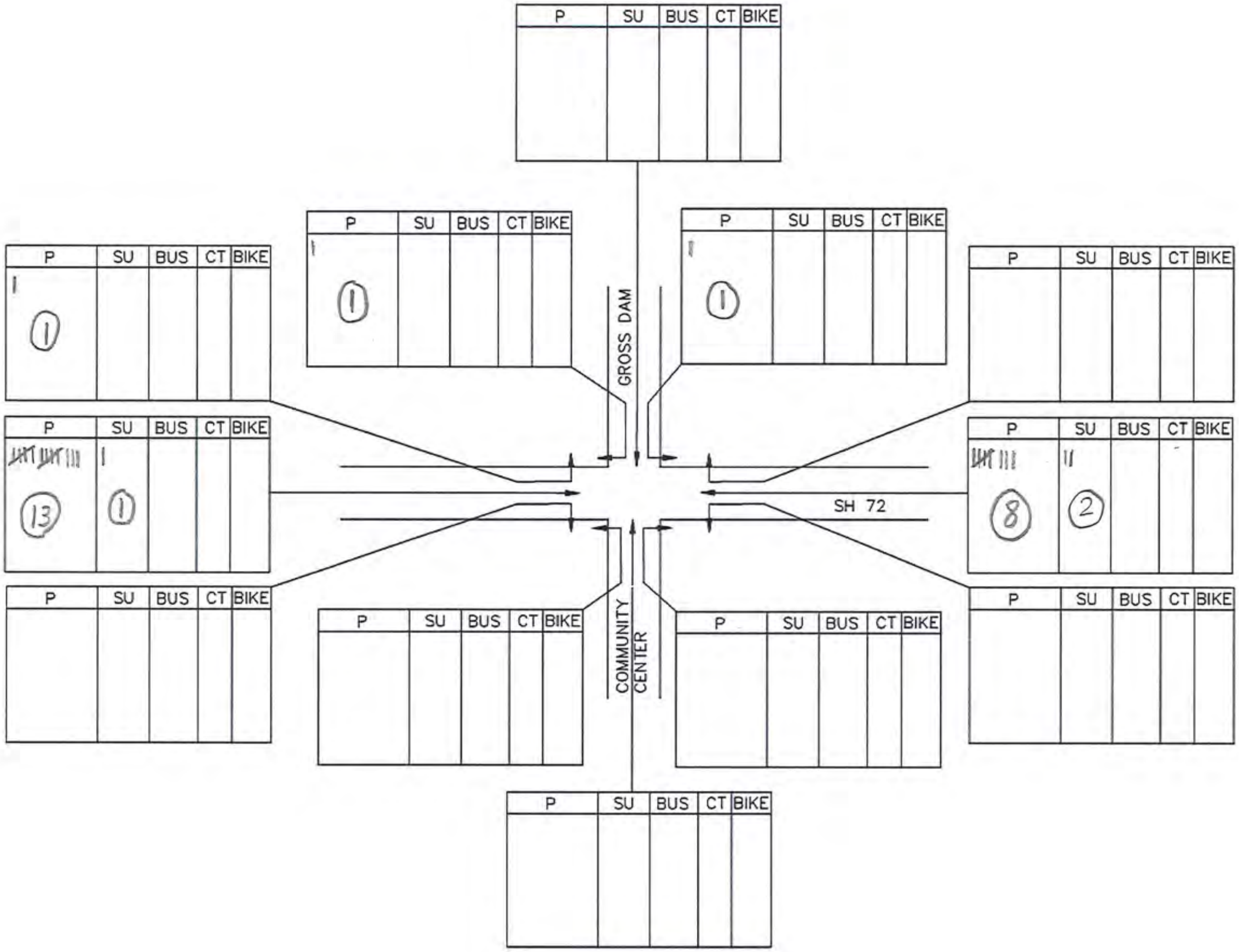
GROSS DAM
SH 72
COMMUNITY CENTER
P
SU
BUS
CT
BIKE
2
2
1
1
12
11
1
1
1

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:45am to 11:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:45-11:00

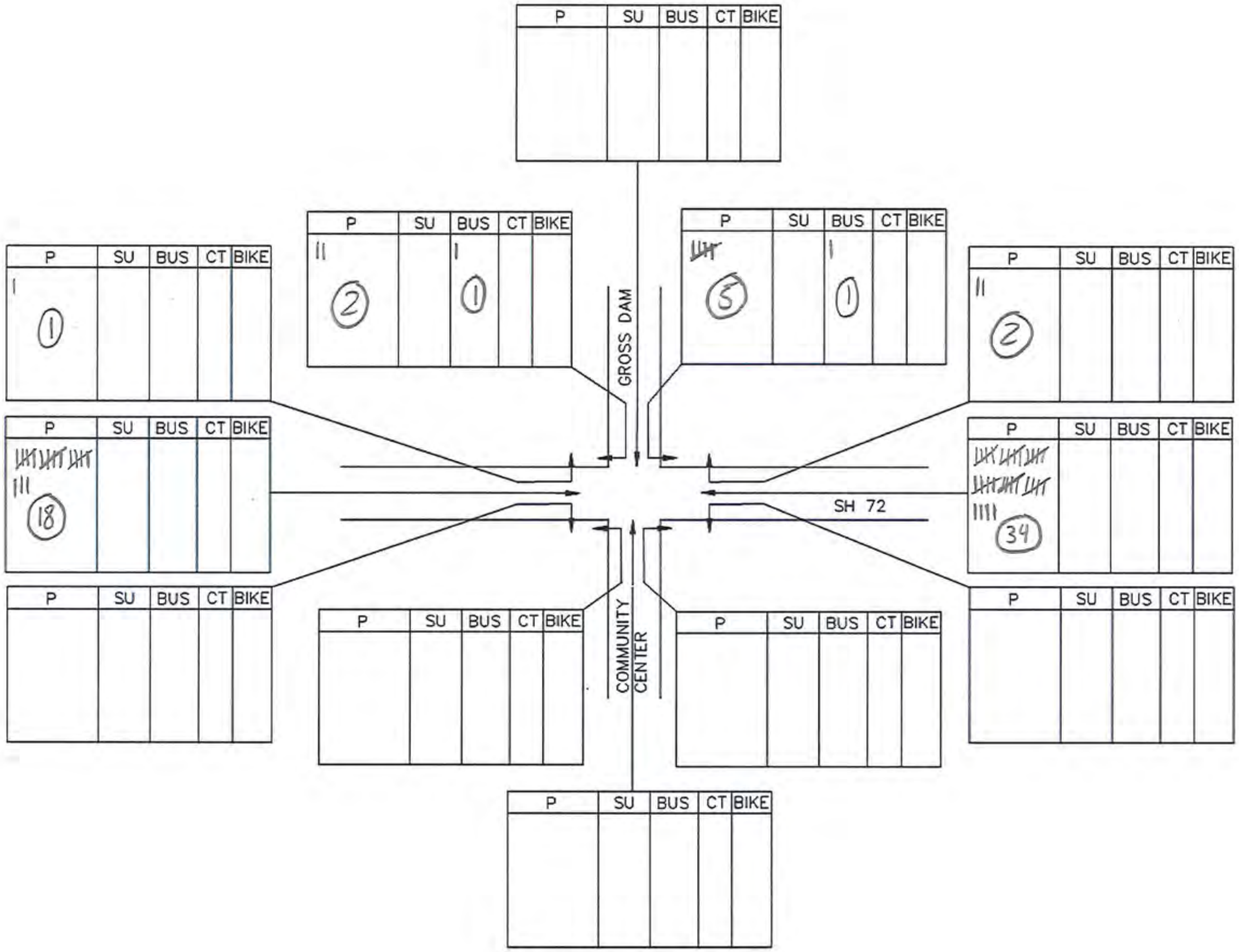
* Motorcycle => One OF The Passenger Counts



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:00pm to 4:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

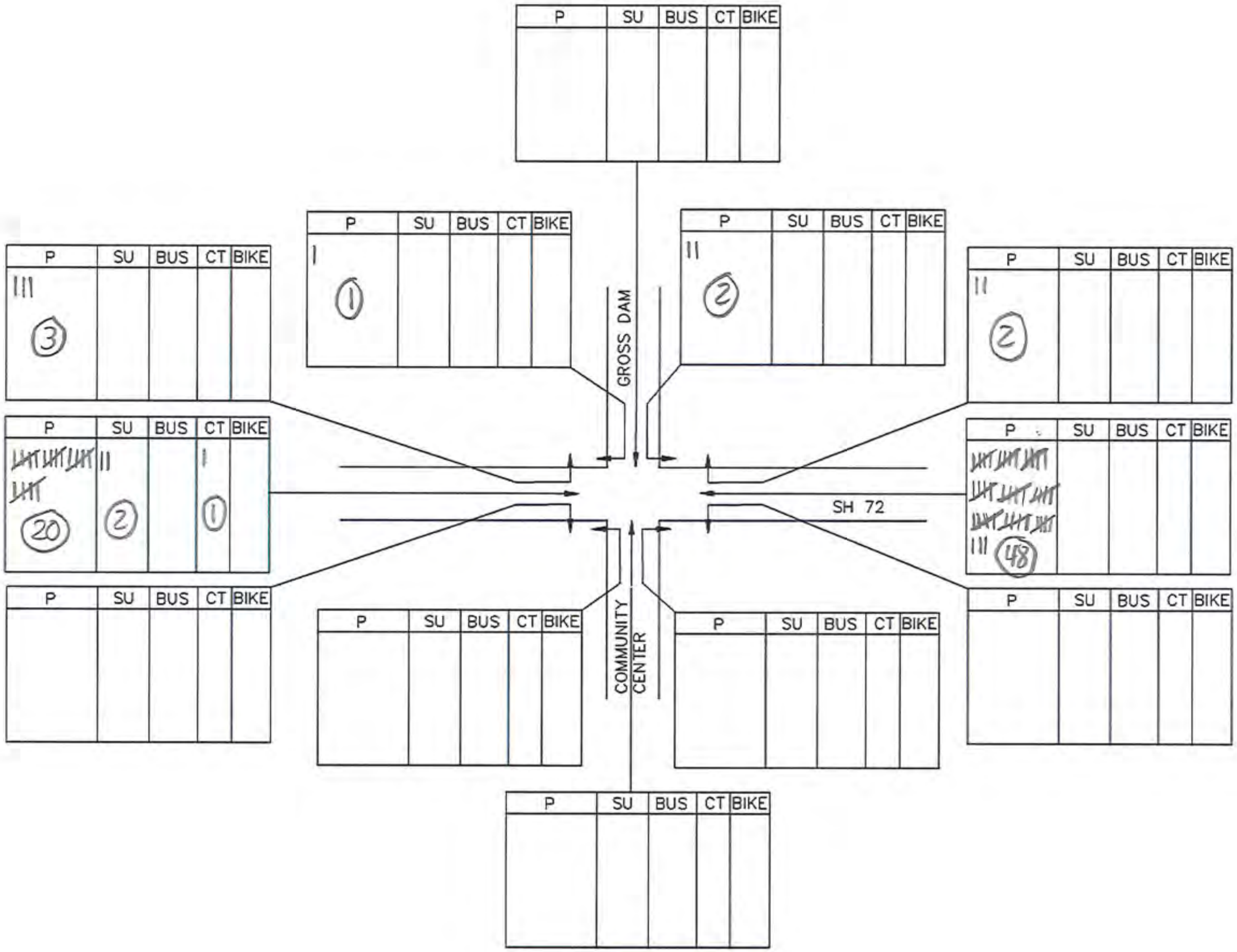
4:00-4:15



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:15pm to 4:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

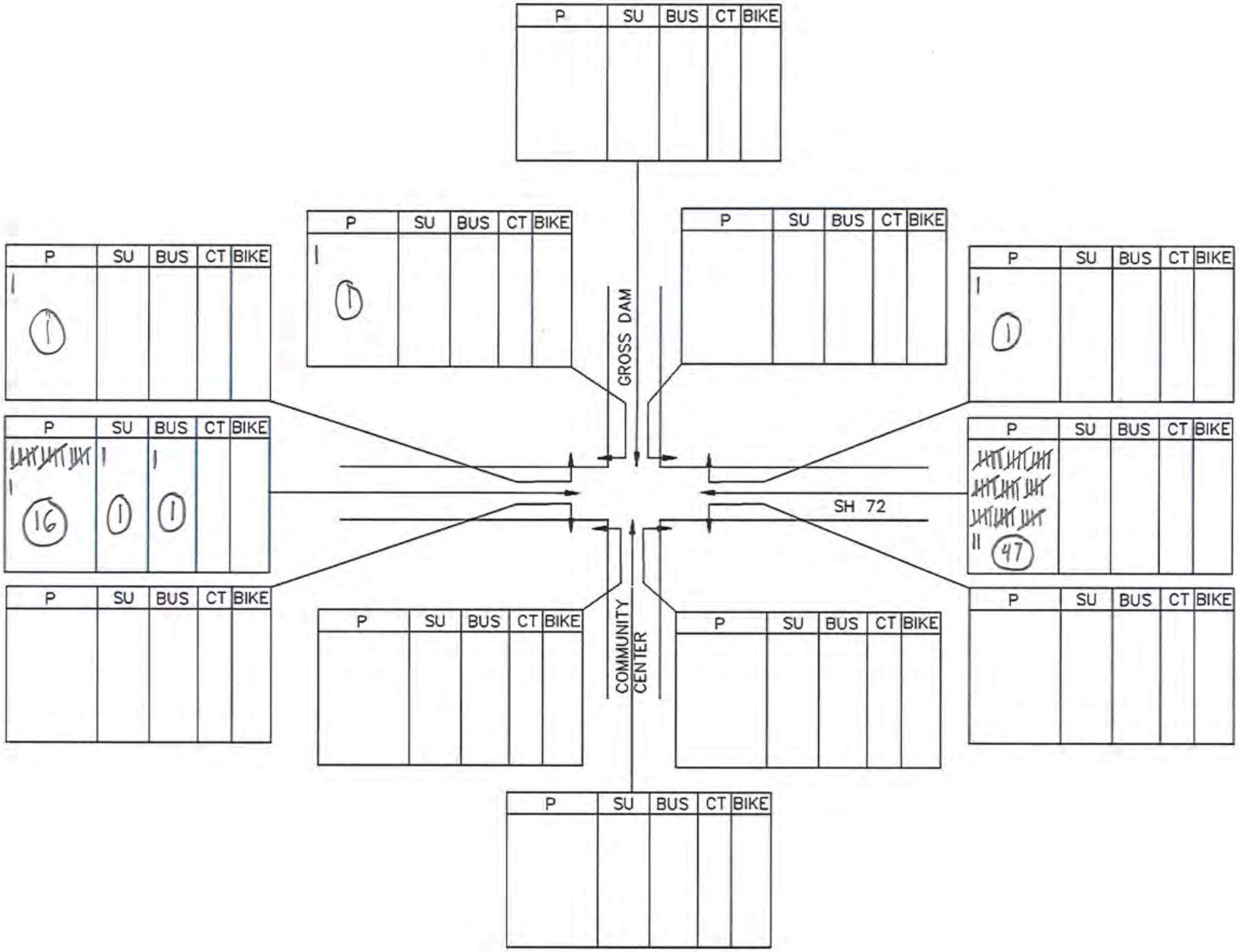
4:15 - 4:30



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:30pm to 4:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

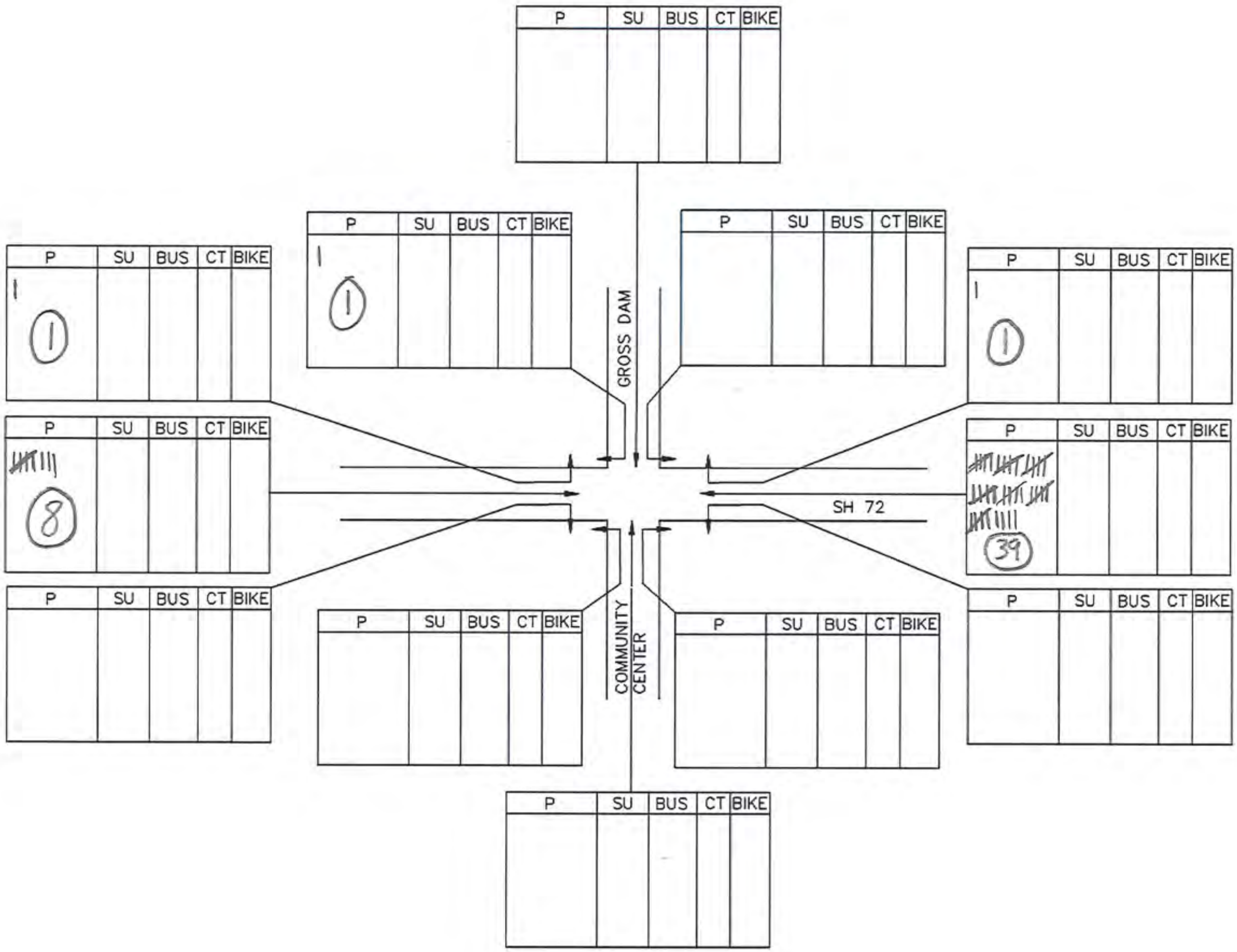
4:30-4:45



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:45pm to 5:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

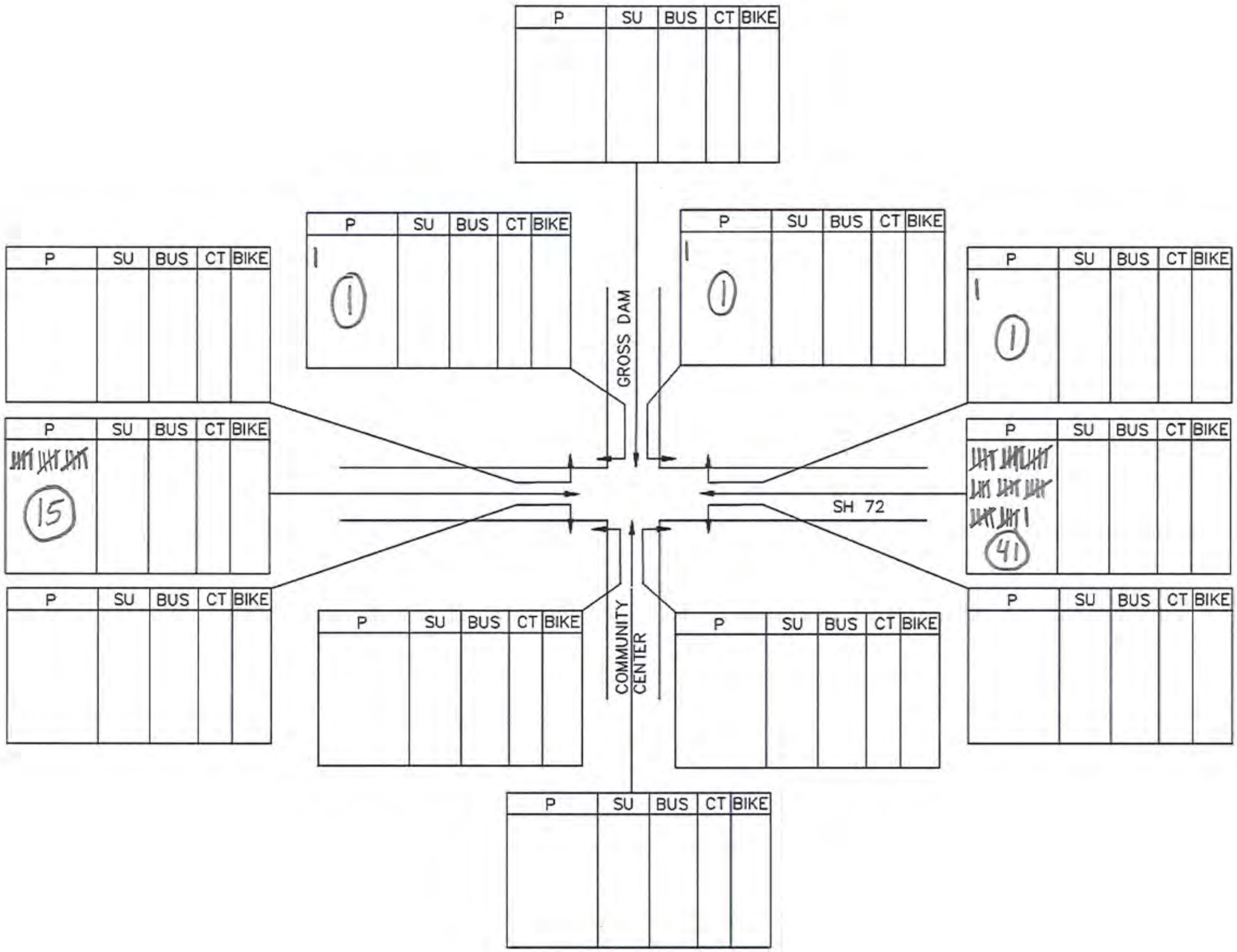
4:45 - 5:00



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:00pm to 5:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

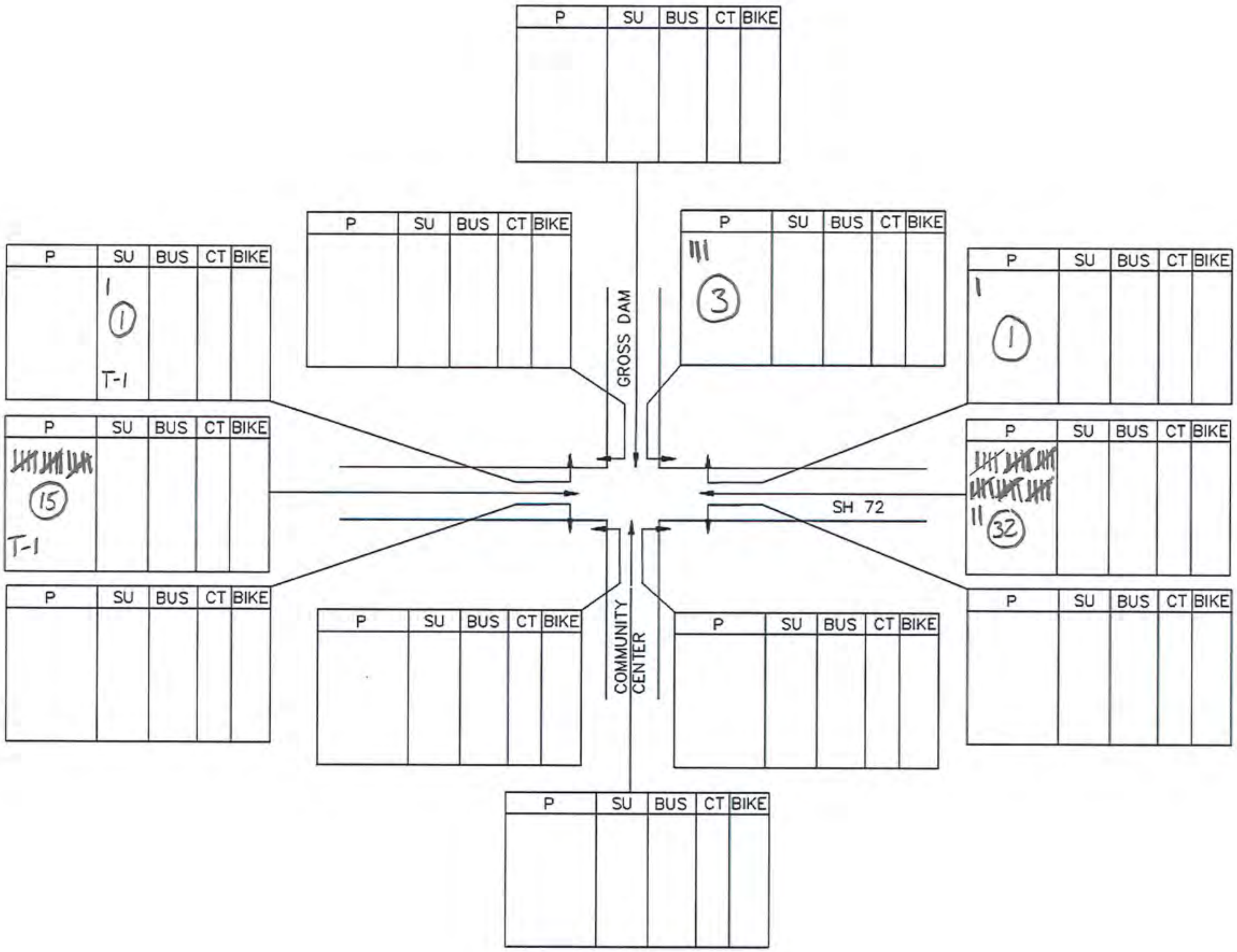
5:00-5:15



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/6/15
Time Period: 4-6pm
Time Increment: 5:15pm to 5:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

5:15 - 5:30

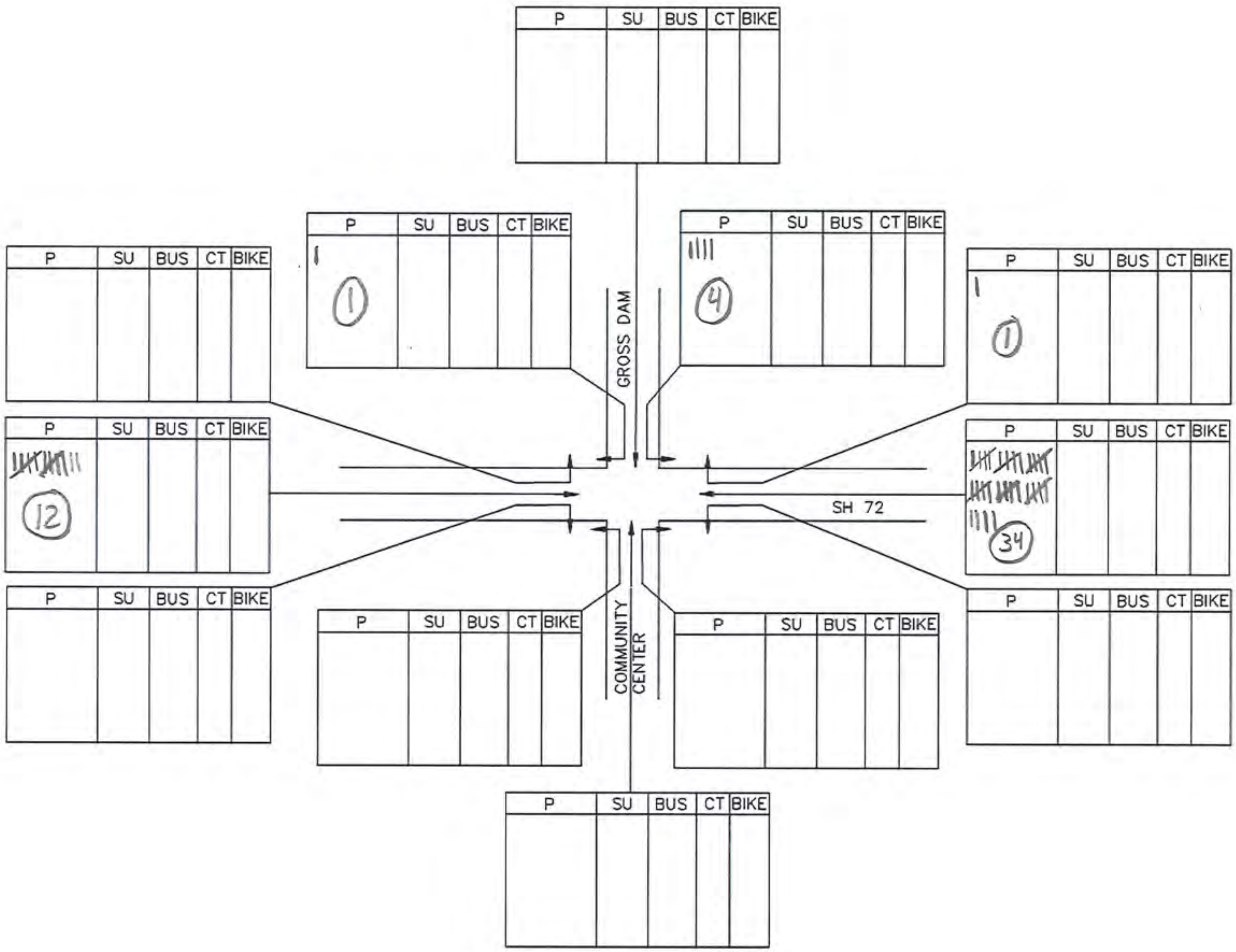


* Trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:30pm to 5:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

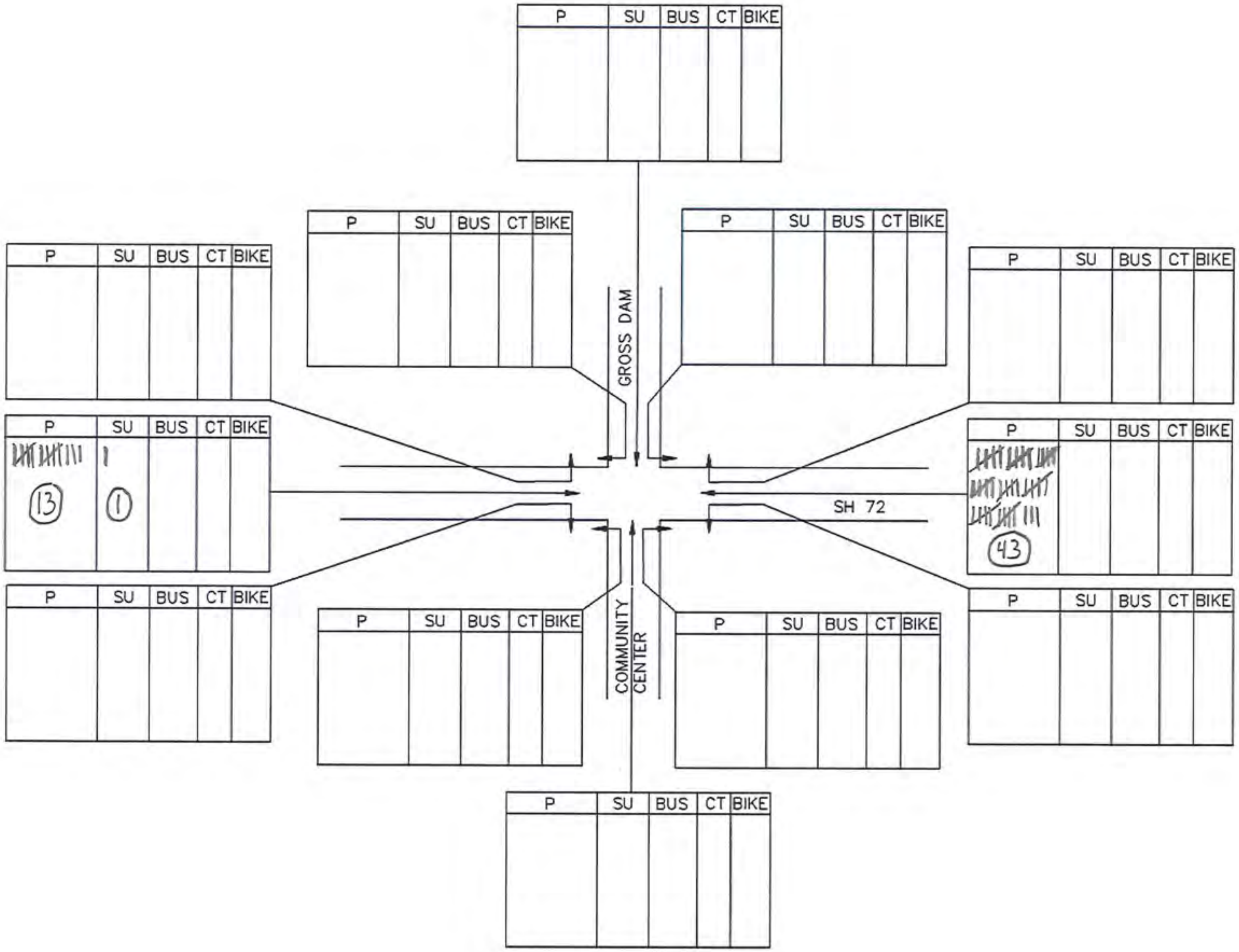
5:30-5:45



SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Gross Dam Road
Date: 12/18/15
Time Period: 4-6pm
Time Increment: 5:45pm to 6:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

5:45-6:00



Intersection: SH 72 and Crescent Park Drive

Time Increment	SH 72				Crescent Park		Total
	Left EB	Through WB	Through EB	Right WB	Left EB	Right WB	
9-9:15	0	19	33	0	5	1	58
9:15-9:30	0	7	39	4	8	0	58
9:30-9:45	0	10	17	3	4	0	34
9:45-10	0	19	23	1	3	0	46
10-10:15	0	14	22	1	2	1	40
10:15-10:30	1	18	13	1	5	0	38
10:30-10:45	0	15	22	2	6	0	45
10:45-11	0	11	17	0	1	0	29

Time Increment	SH 72				Crescent Park		Total
	Left EB	Through WB	Through EB	Right WB	Left EB	Right WB	
4-4:15	1	48	24	4	6	2	85
4:15-4:30	1	54	29	7	5	1	97
4:30-4:45	0	43	28	12	3	0	86
4:45-5	0	45	14	8	3	1	71
5-5:15	0	58	24	11	1	0	94
5:15-5:30	0	40	17	6	0	0	63
5:30-5:45	0	60	19	11	3	0	93
5:45-6	0	63	17	5	3	0	88

Indicates peak hour

Intersection:	SH 72 and Skyline Drive

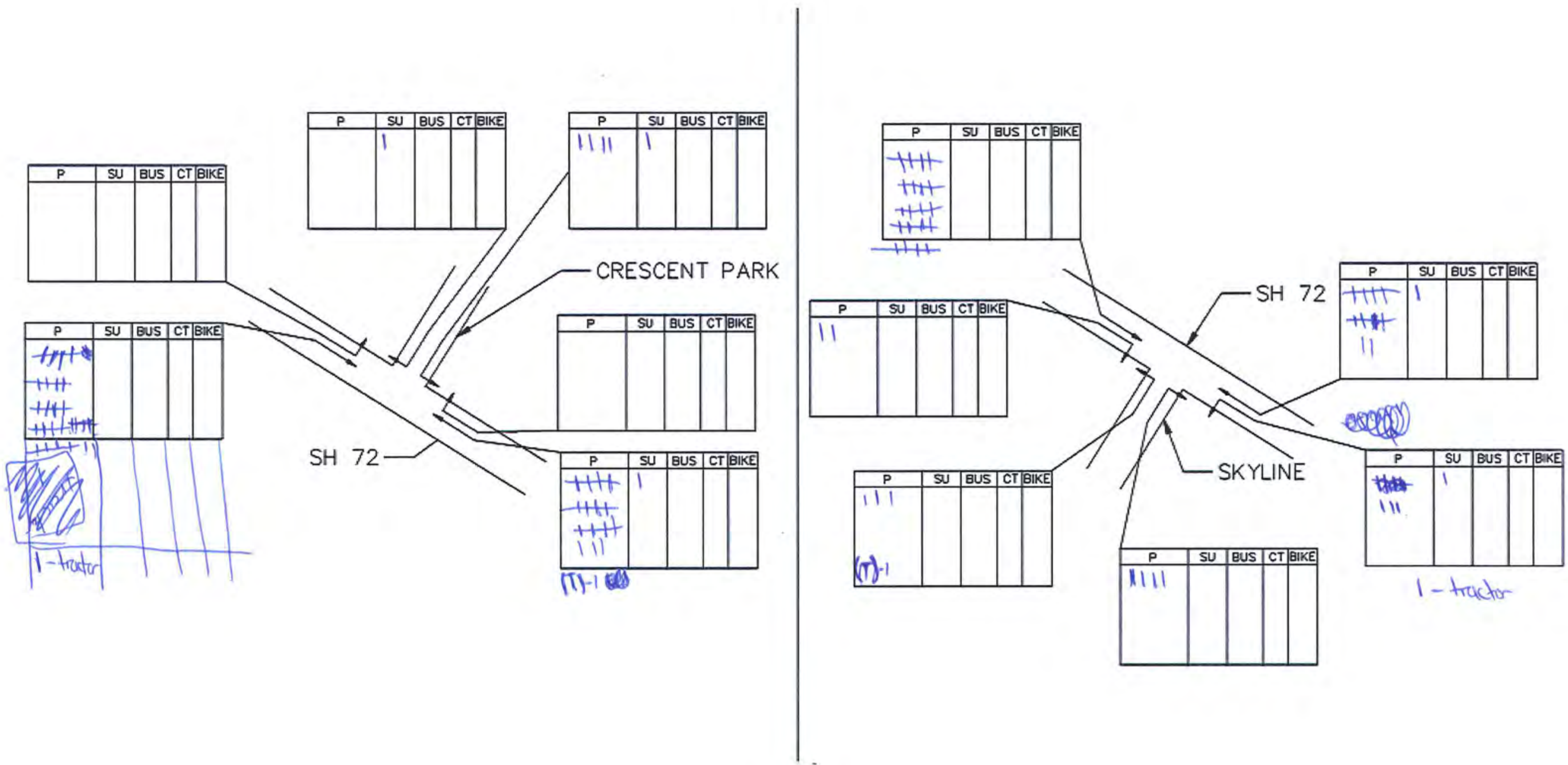
Time Increment	SH 72				Skyline		Total
	Left WB	Through WB	Through EB	Right EB	Left WB	Right EB	
9-9:15	5	13	25	2	3	4	52
9:15-9:30	2	9	35	6	3	6	61
9:30-9:45	0	14	16	0	2	6	38
9:45-10	3	15	21	0	1	5	45
10-10:15	2	14	19	0	0	2	37
10:15-10:30	2	16	17	0	1	5	41
10:30-10:45	1	16	23	0	1	2	43
10:45-11	2	8	20	0	1	2	33

Time Increment	SH 72				Skyline		Total
	Left WB	Through WB	Through EB	Right EB	Left WB	Right EB	
4-4:15	7	40	19	1	4	6	77
4:15-4:30	12	49	21	2	5	4	93
4:30-4:45	12	49	21	3	4	2	91
4:45-5	12	50	8	2	3	6	81
5-5:15	9	63	12	2	6	3	95
5:15-5:30	8	38	7	1	5	2	61
5:30-5:45	7	68	16	0	7	0	98
5:45-6	9	61	16	1	5	3	95

Indicates peak hour

SH 72 and Gross Dam Road Traffic Counts

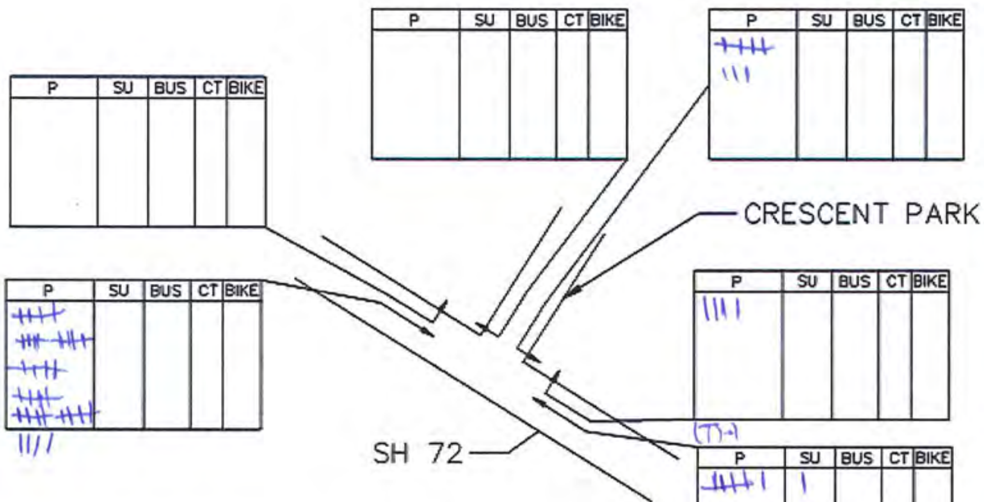
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:00am to 9:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

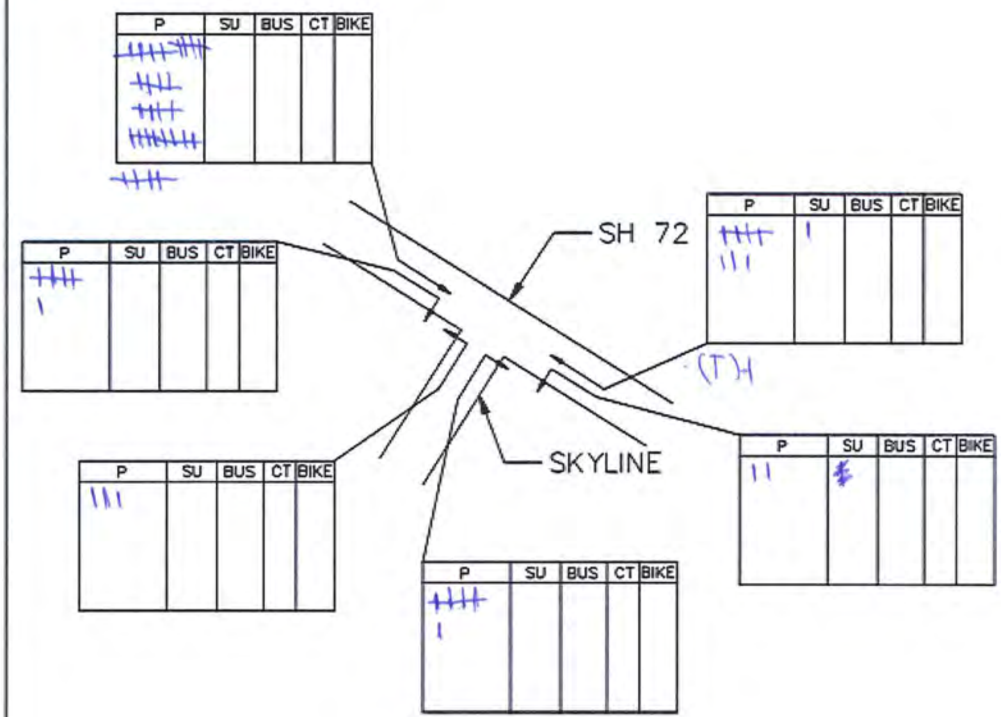


* The tractors are a separate category + not already counted w/ another vehicle category
* The trailers ticks indicate the number of under the vehicle column w/ trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:15am to 9:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

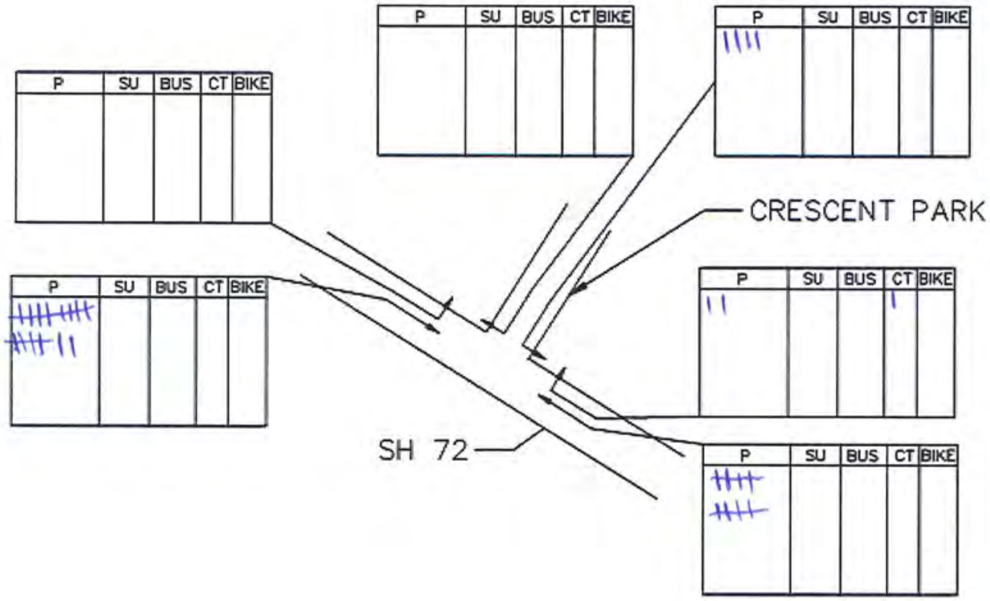


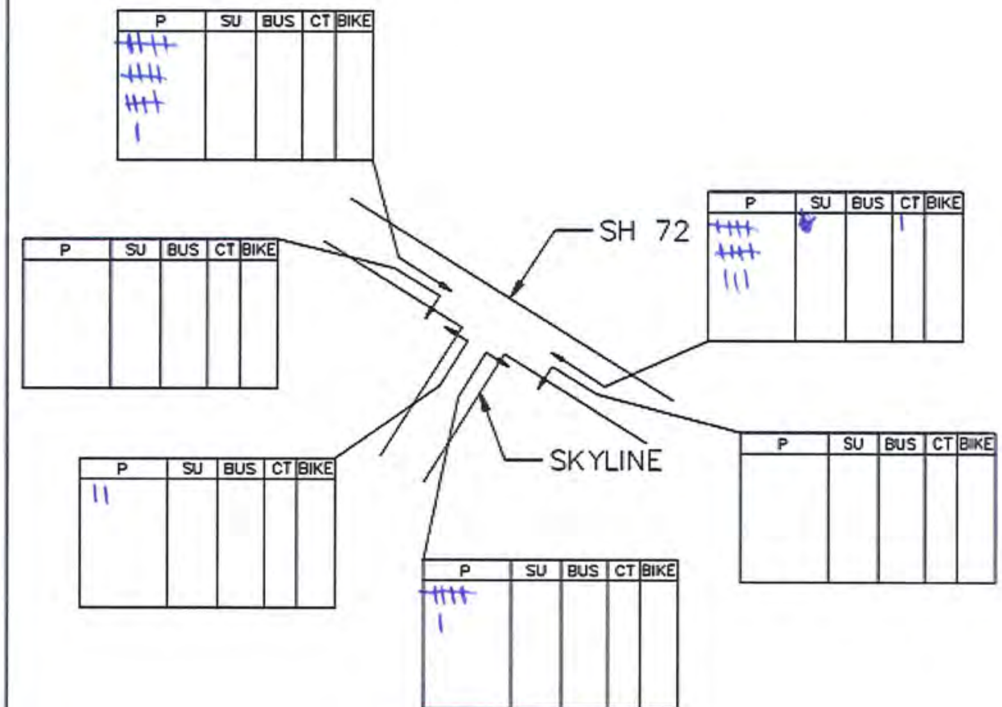


* The trailer ticks indicate the number of vehicles under the vehicle column with trailers and one "double" marked but counted once

SH 72 and Gross Dam Road Traffic Counts

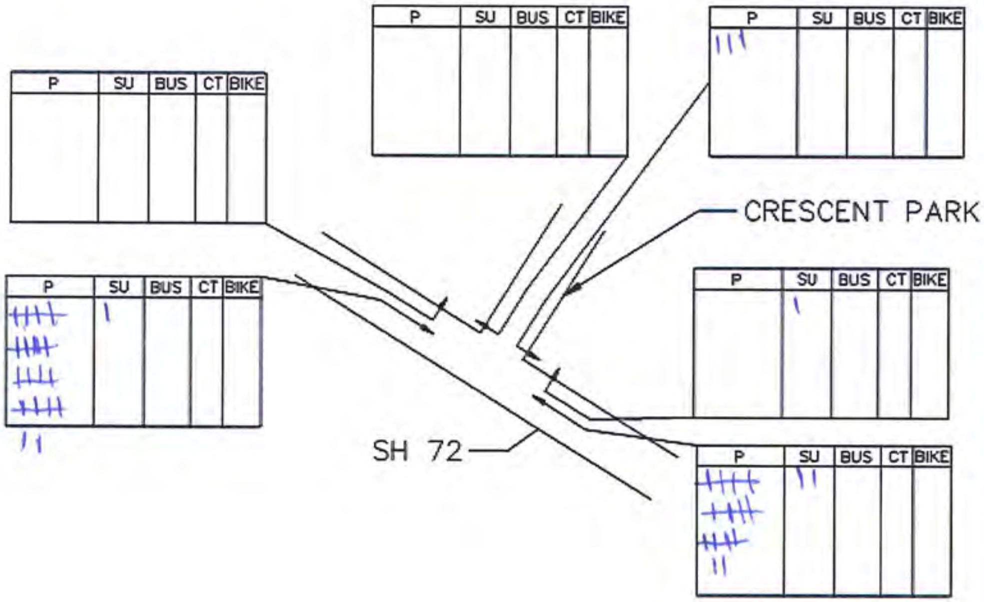
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:30am to 9:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

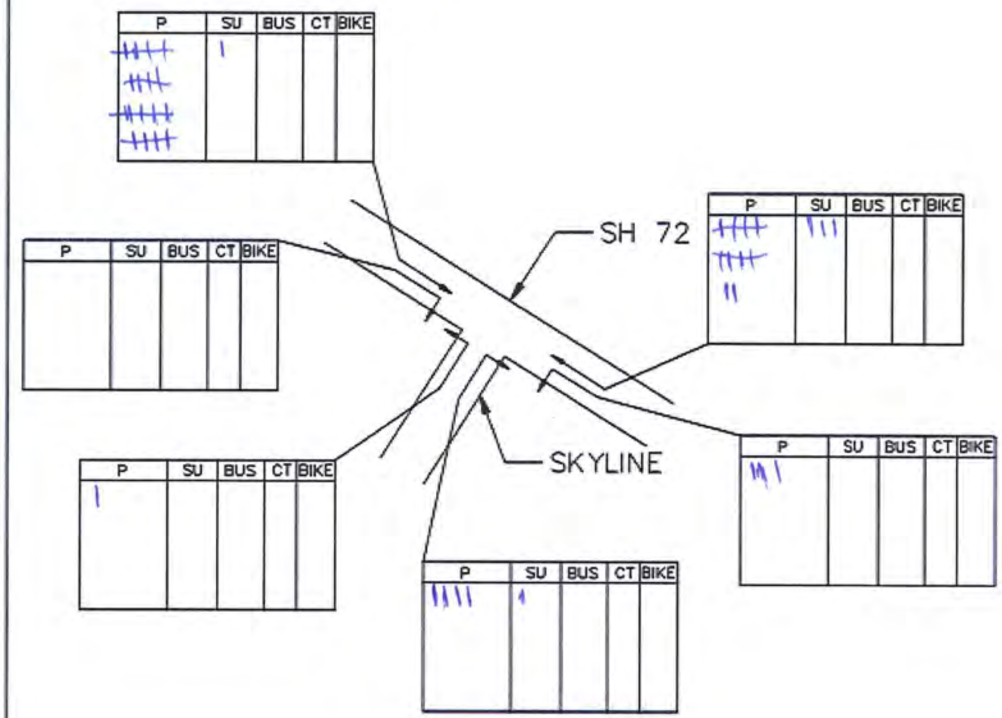

P SU BUS CT BIKE
CRESCENT PARK
SH 72


P SU BUS CT BIKE
SH 72
SKYLINE

SH 72 and Gross Dam Road Traffic Counts

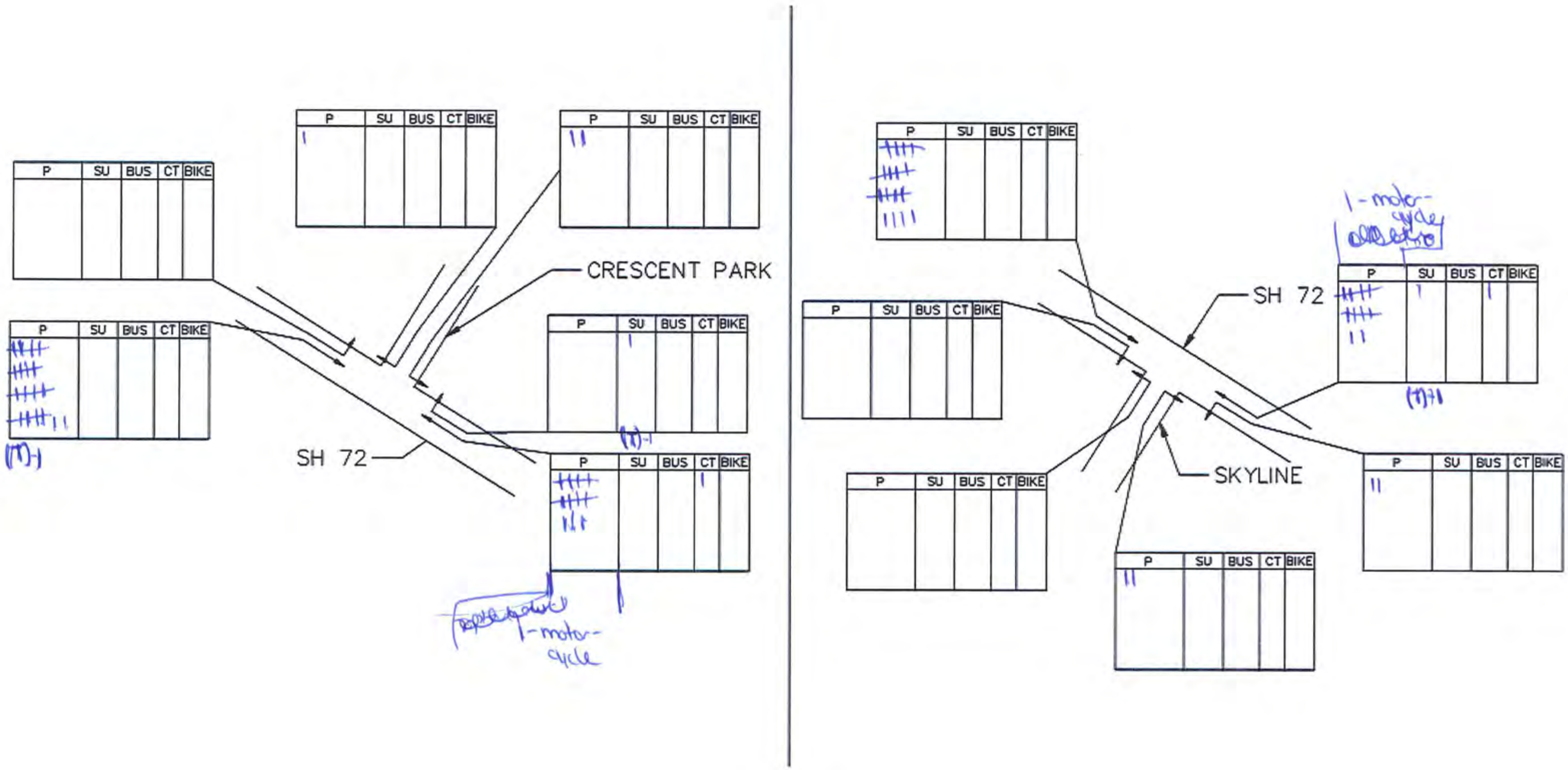
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:45am to 10:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)


CRESCENT PARK
SH 72
P SU BUS CT BIKE


SH 72
SKYLINE
P SU BUS CT BIKE

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:00am to 10:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

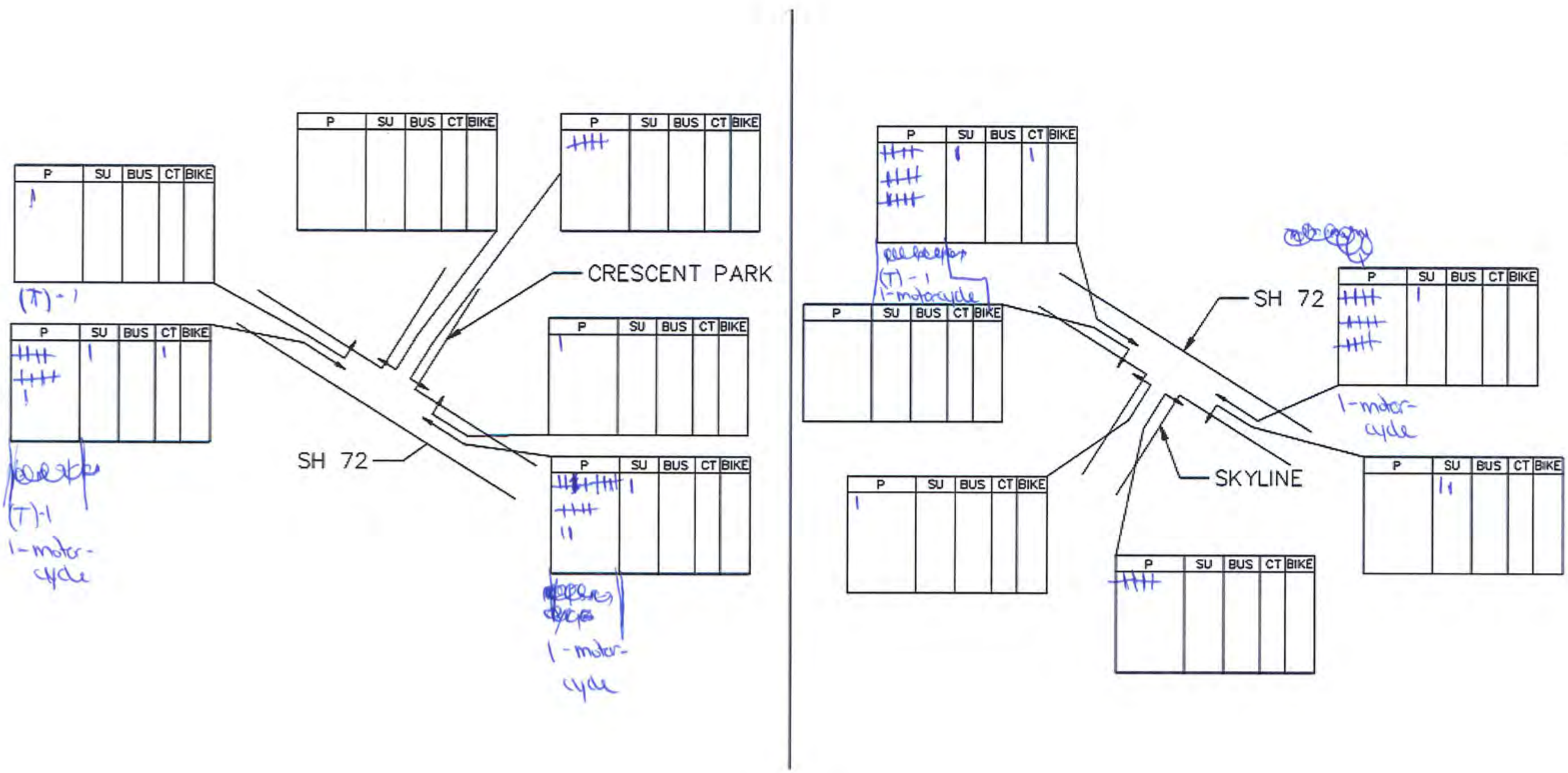


* The trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

* The motorcycles are indicated but tallied under "P" – they are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

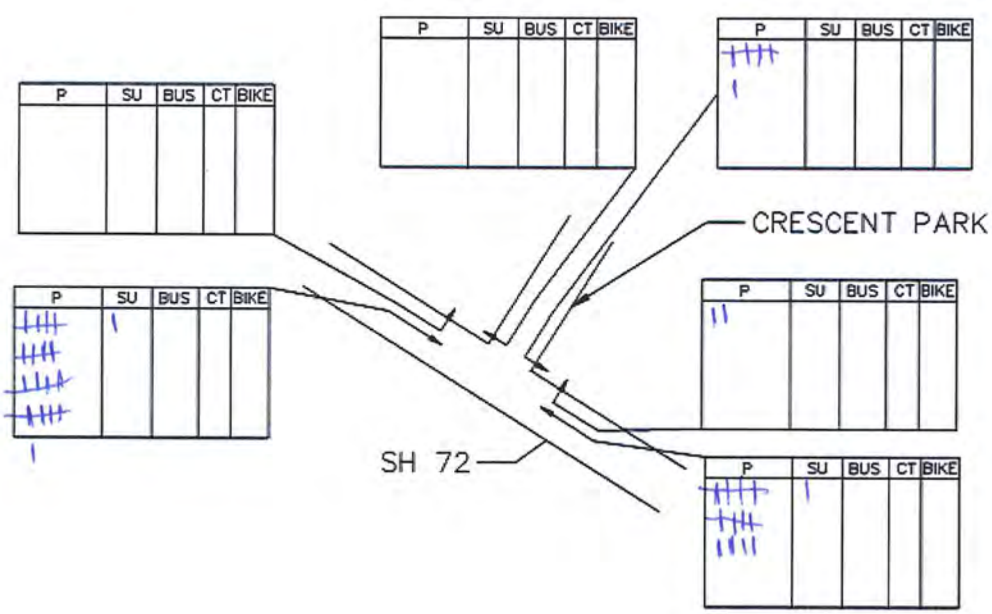
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:15am to 10:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

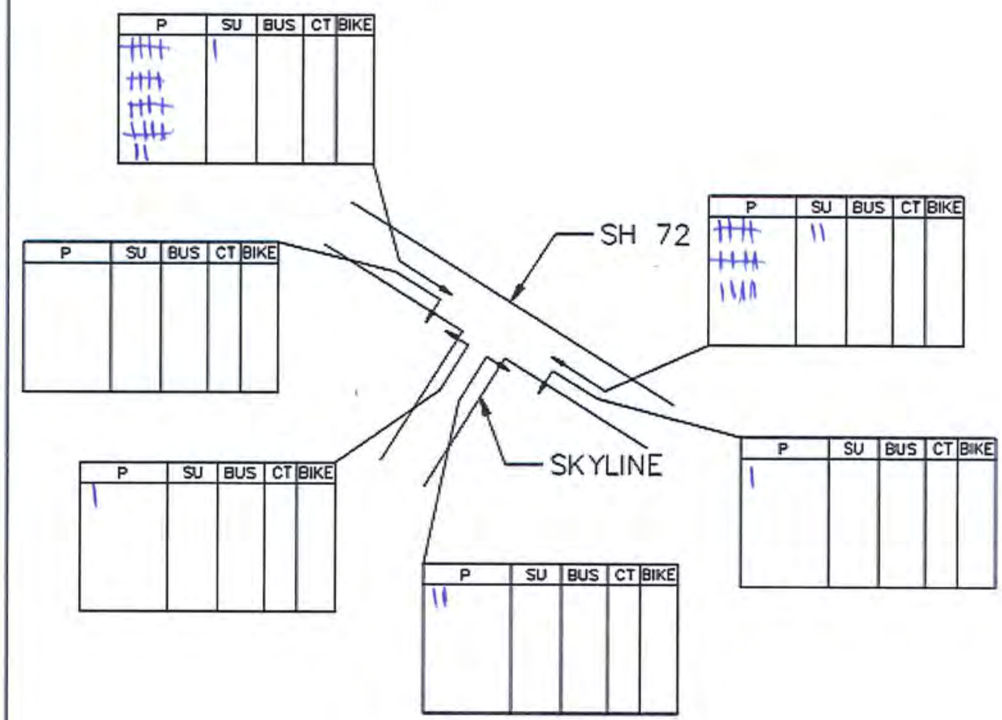


* The motorcycles are indicated but tallied under "P" — they are double marked but counted once.
* The trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

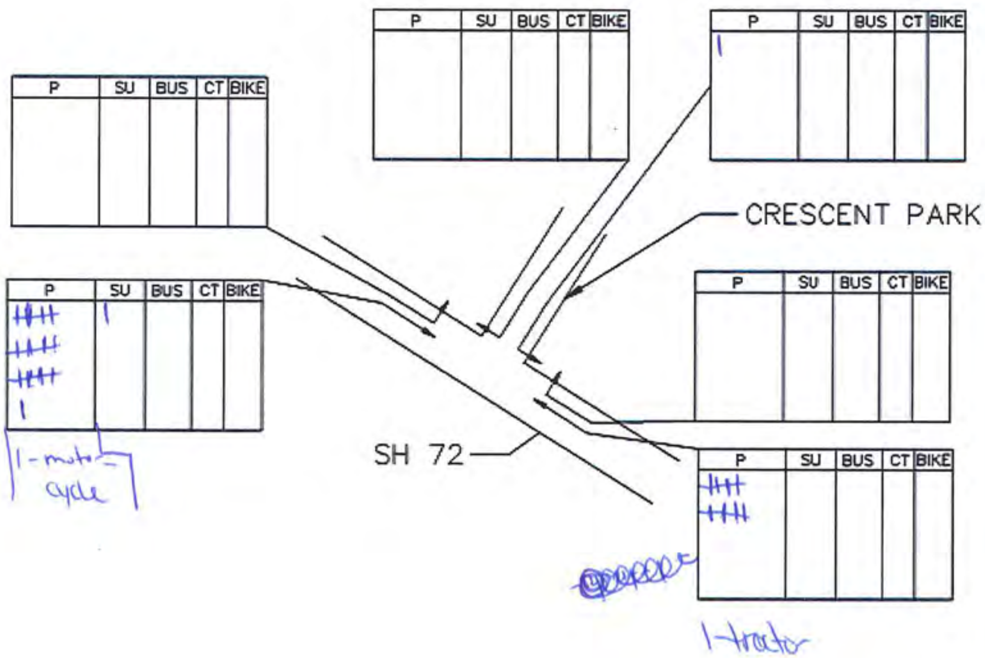
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:30am to 10:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

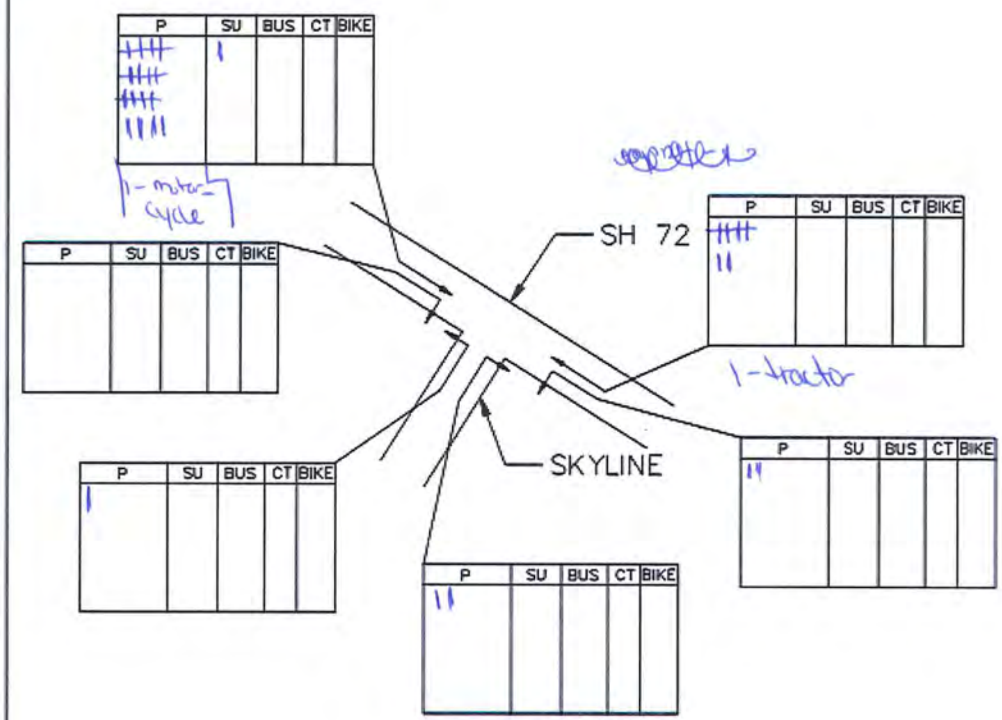

P
SU
BUS
CT
BIKE
CRESCENT PARK
SH 72


P
SU
BUS
CT
BIKE
SH 72
SKYLINE

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:45am to 11:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

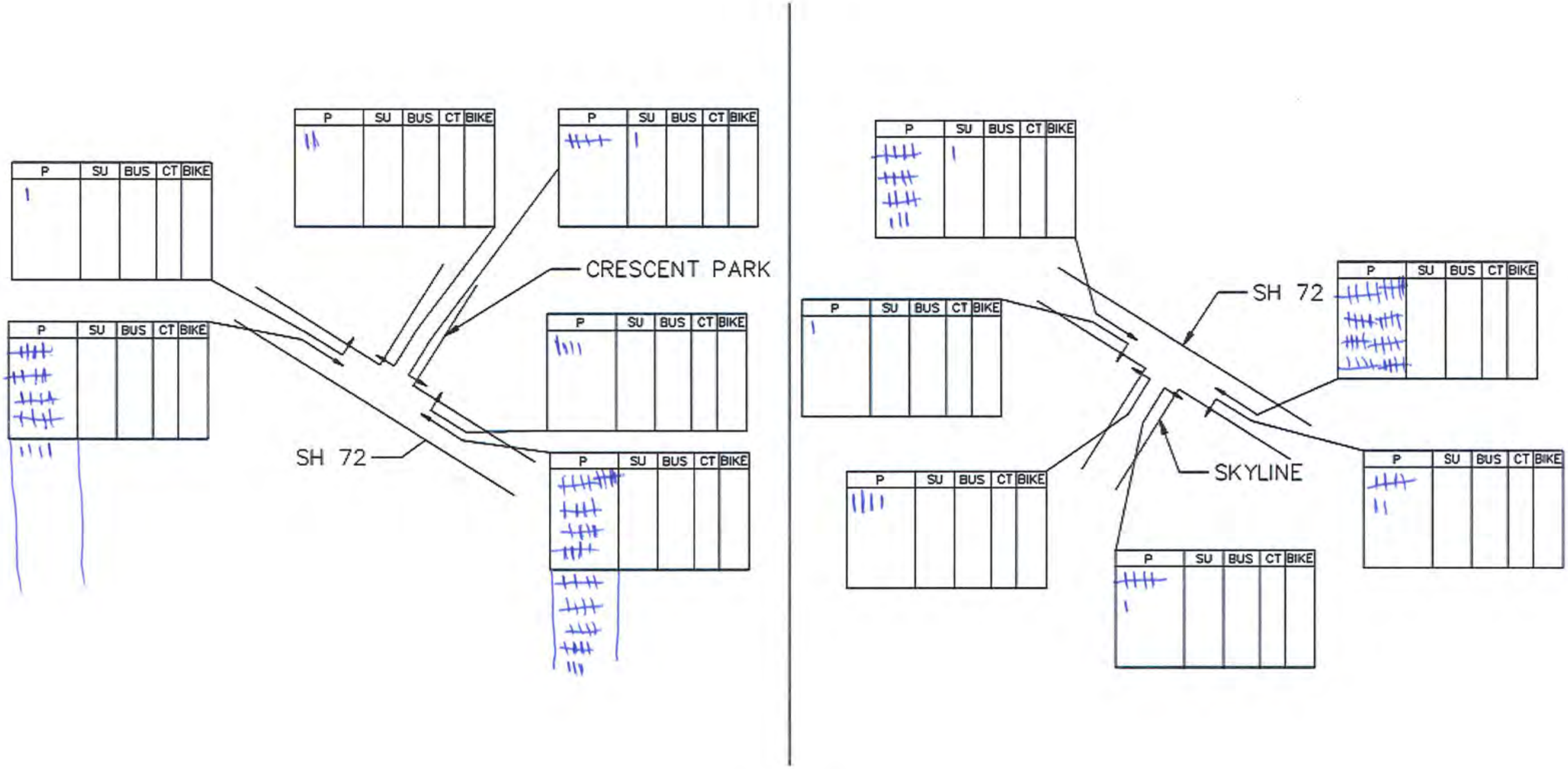




* The motorcycles are indicated but tallied under "P" - they are double marked but counted once
* The tractors are a separate category + not already counted w/ another vehicle category

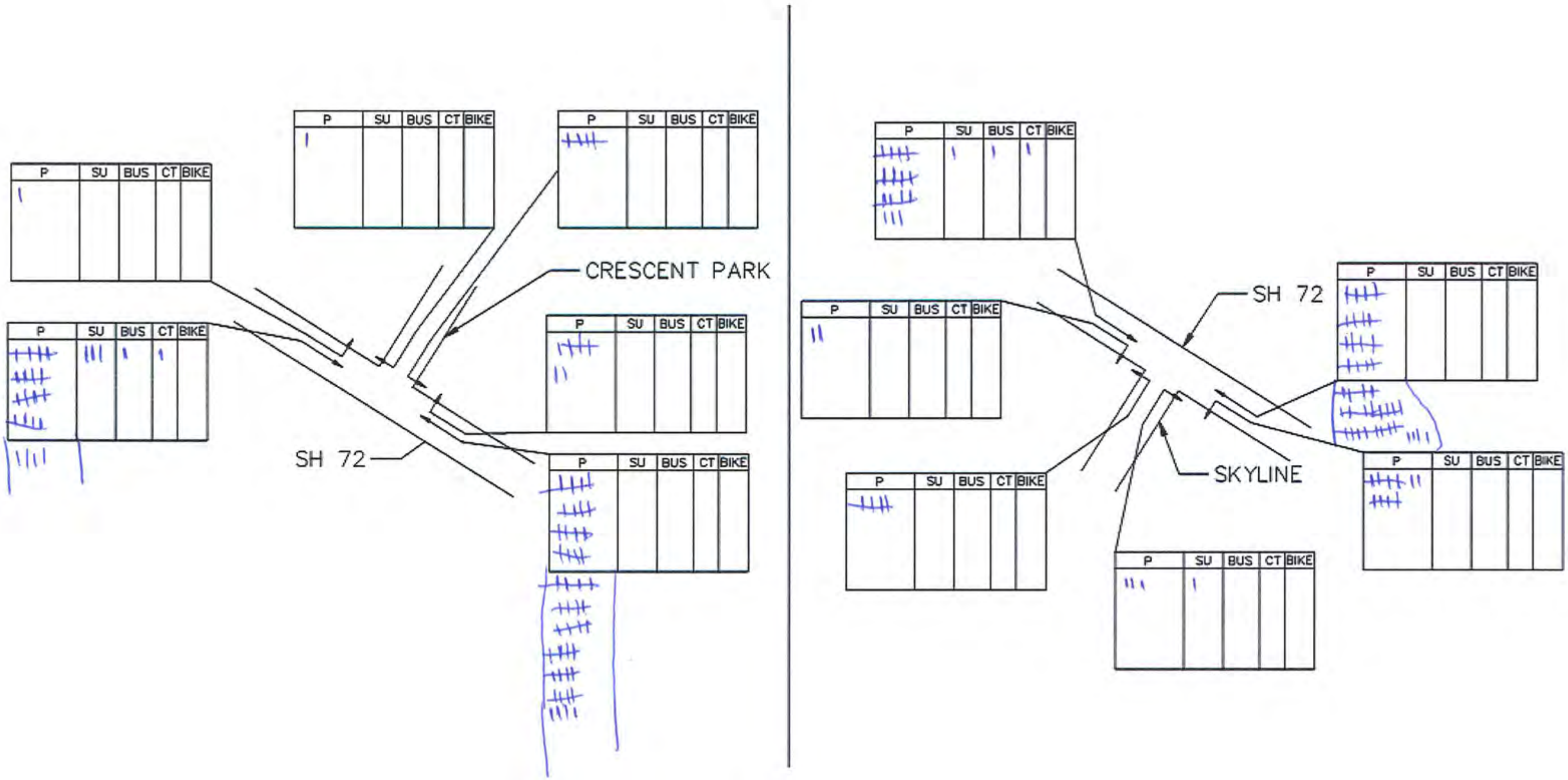
SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:00pm to 4:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)


P SU BUS CT BIKE
CRESCENT PARK
SH 72
SKYLINE

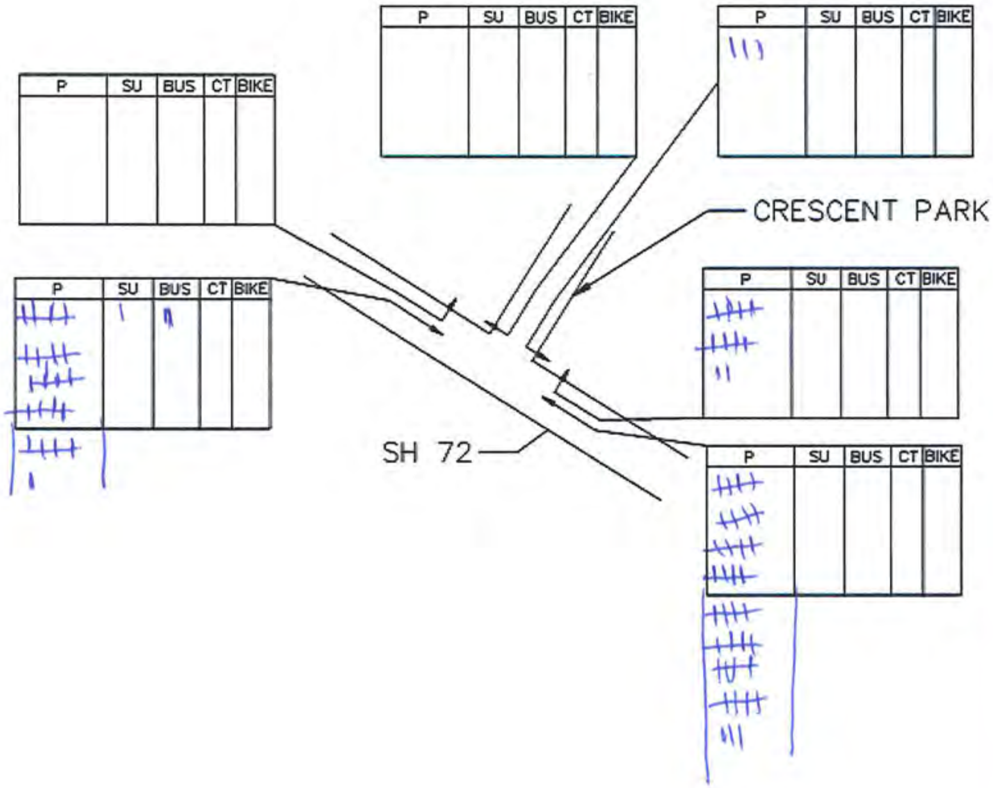
SH 72 and Gross Dam Road Traffic Counts

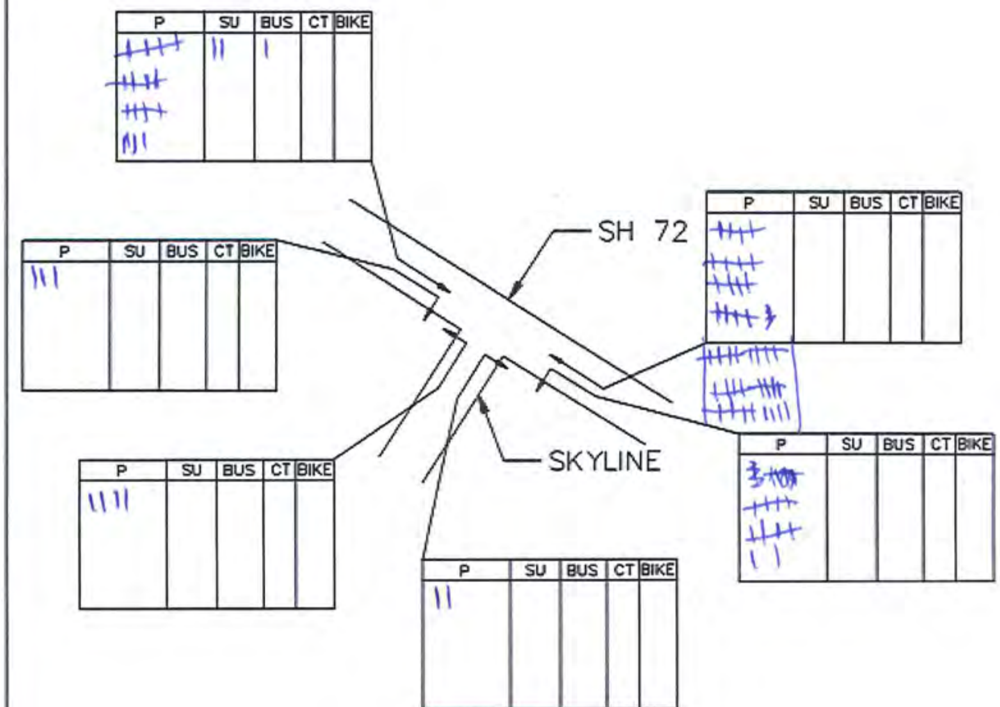
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:15pm to 4:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)


CRESCENT PARK
SH 72
SKYLINE
P
SU
BUS
CT
BIKE

SH 72 and Gross Dam Road Traffic Counts

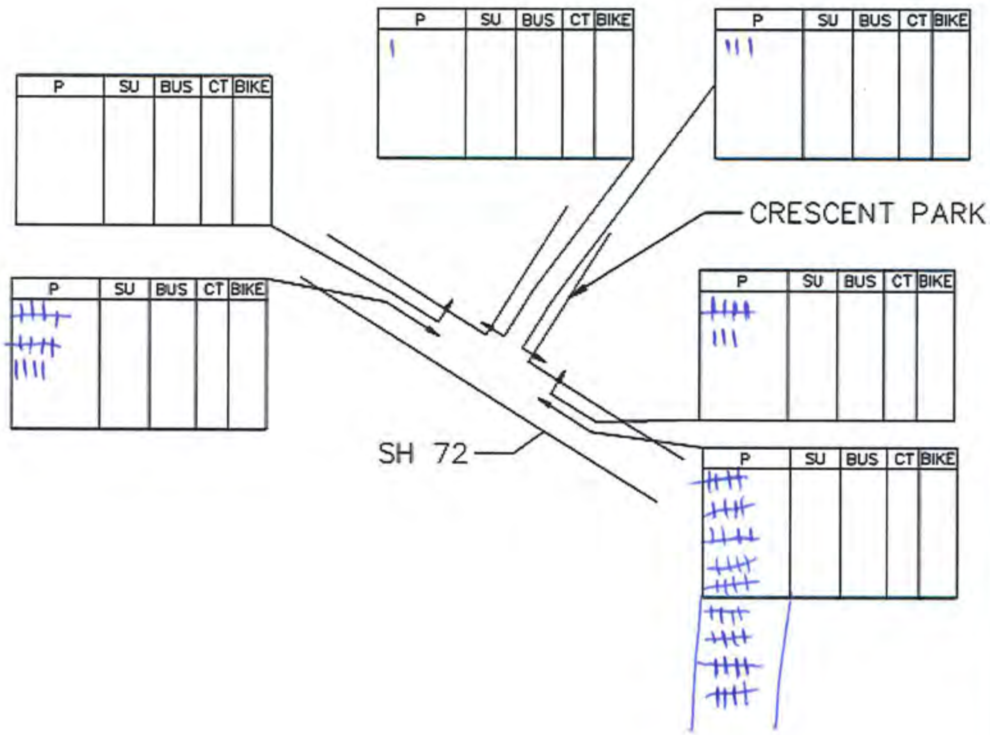
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:30pm to 4:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

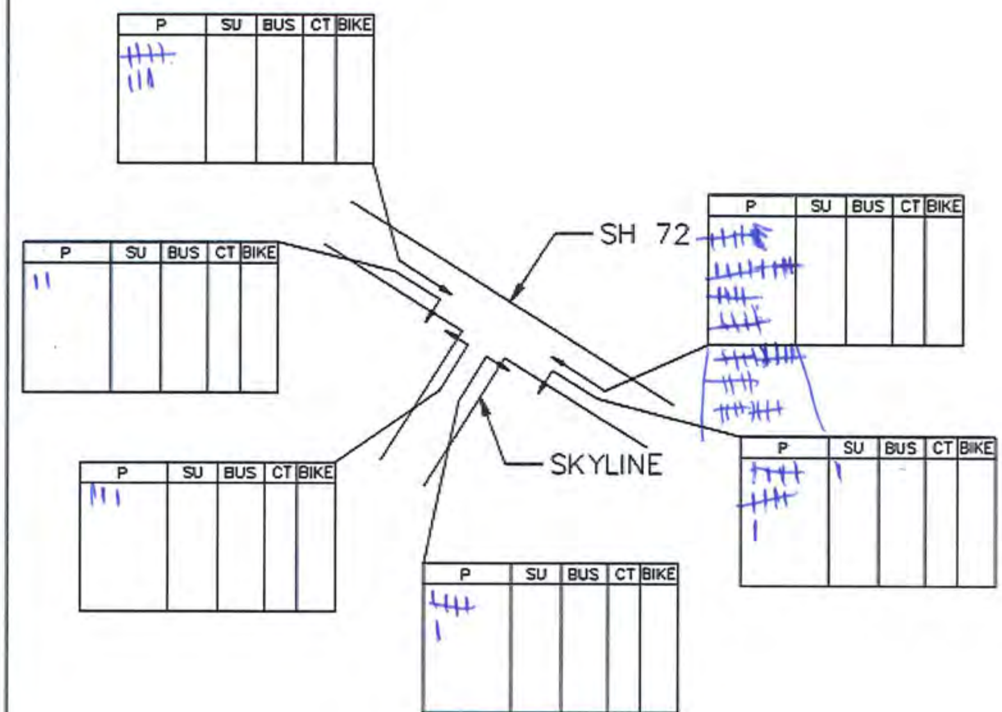

P
SU
BUS
CT
BIKE
CRESCENT PARK
SH 72


P
SU
BUS
CT
BIKE
SH 72
SKYLINE

SH 72 and Gross Dam Road Traffic Counts

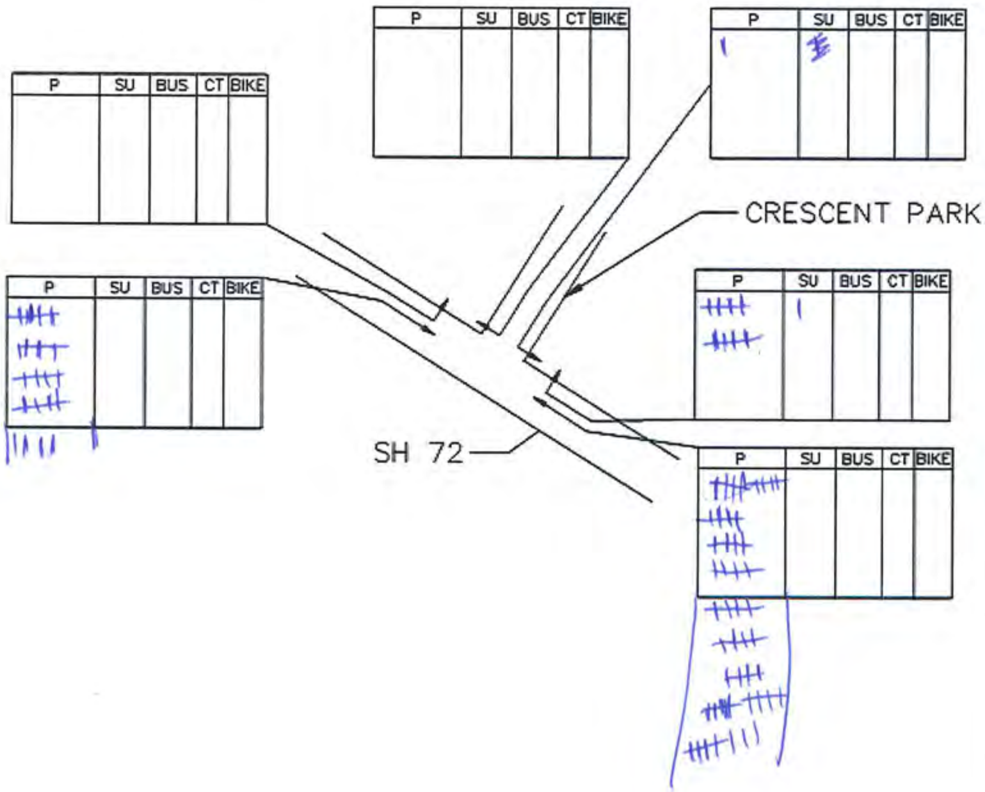
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:45pm to 5:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

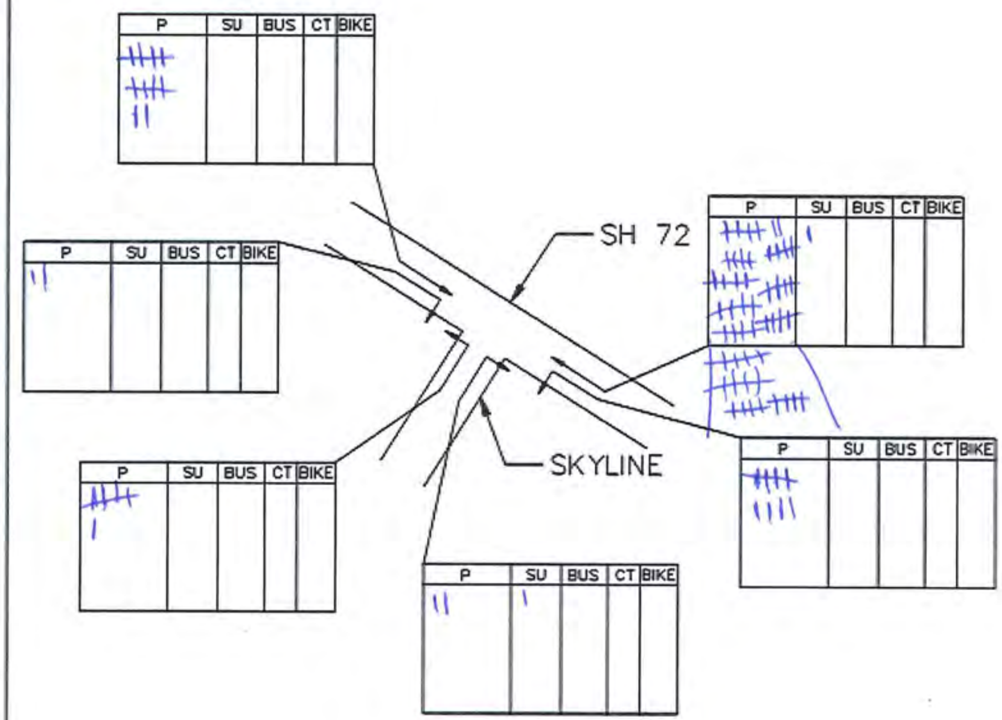

CRESCENT PARK
SH 72
P
SU
BUS
CT
BIKE


SH 72
SKYLINE
P
SU
BUS
CT
BIKE

SH 72 and Gross Dam Road Traffic Counts

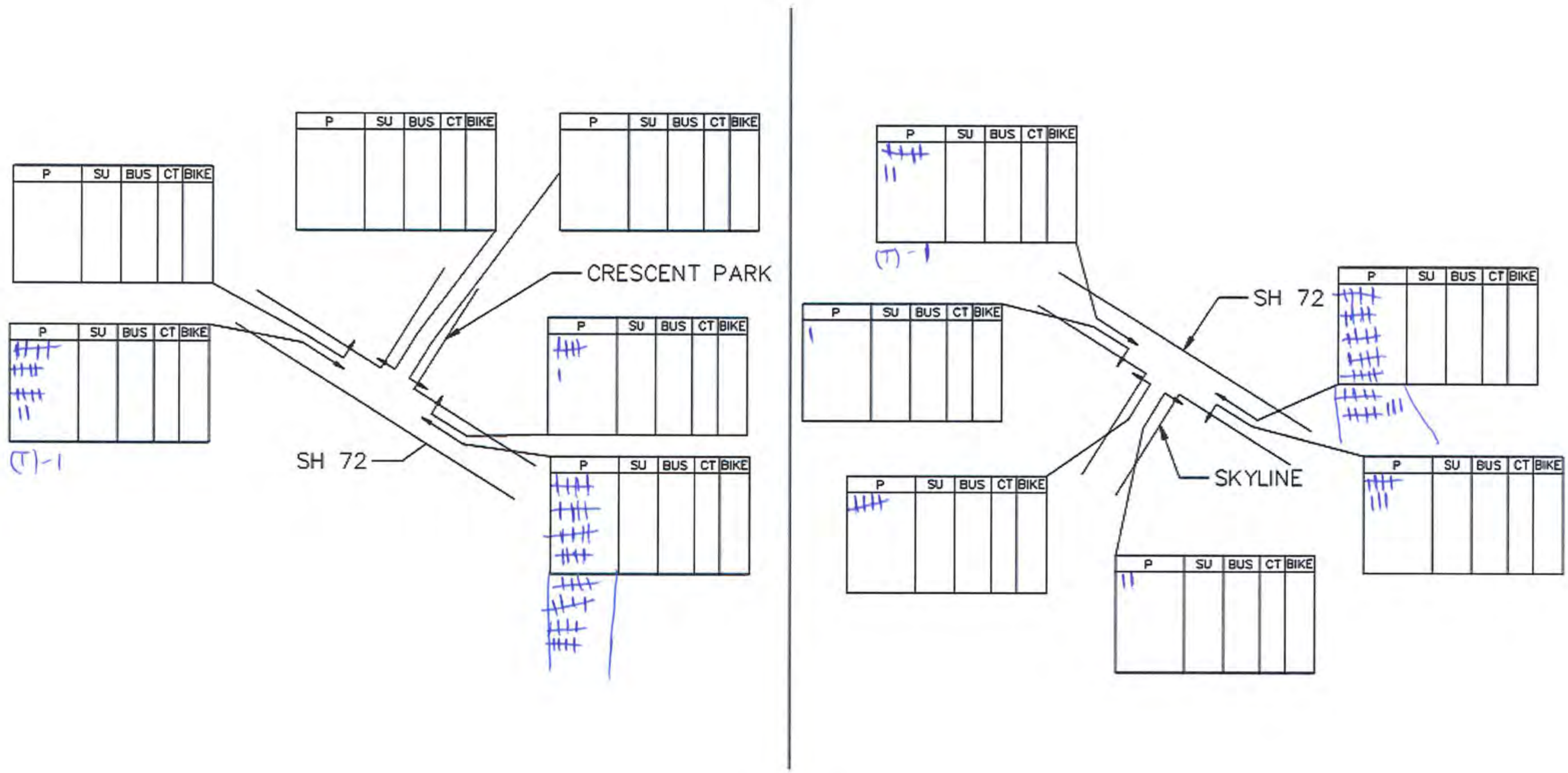
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:00pm to 5:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)


P | SU | BUS | CT | BIKE
CRESCENT PARK
SH 72


P | SU | BUS | CT | BIKE
SH 72
SKYLINE

SH 72 and Gross Dam Road Traffic Counts

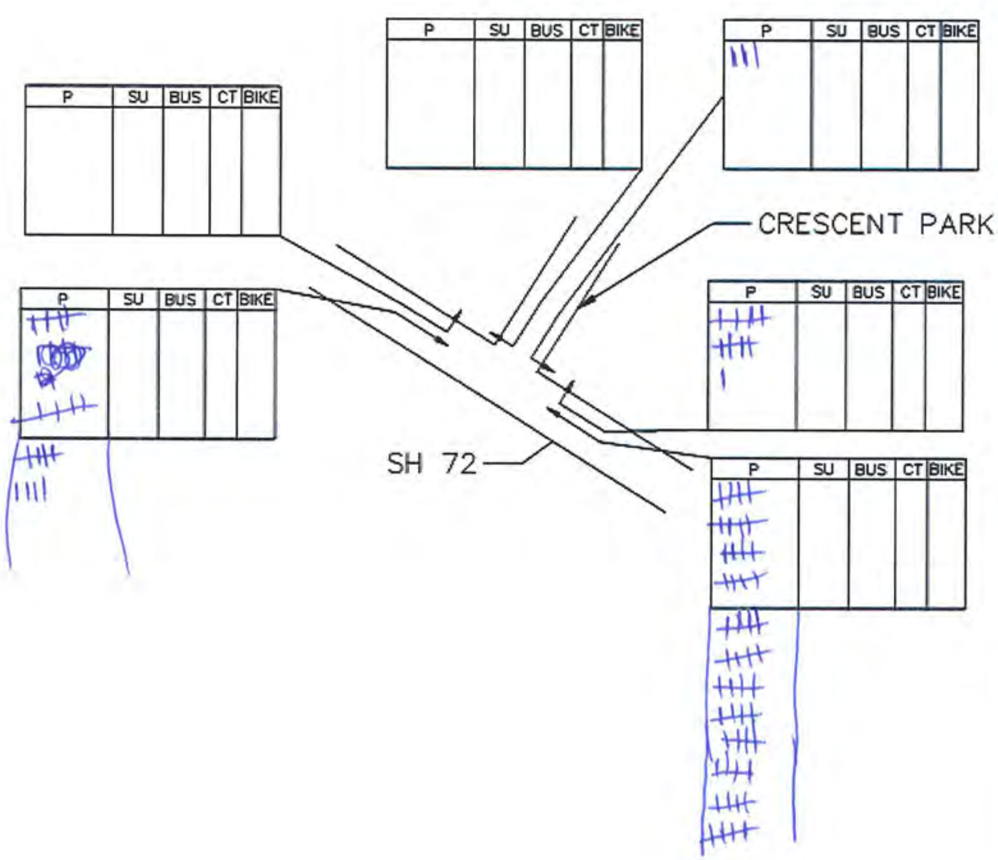
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:15pm to 5:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

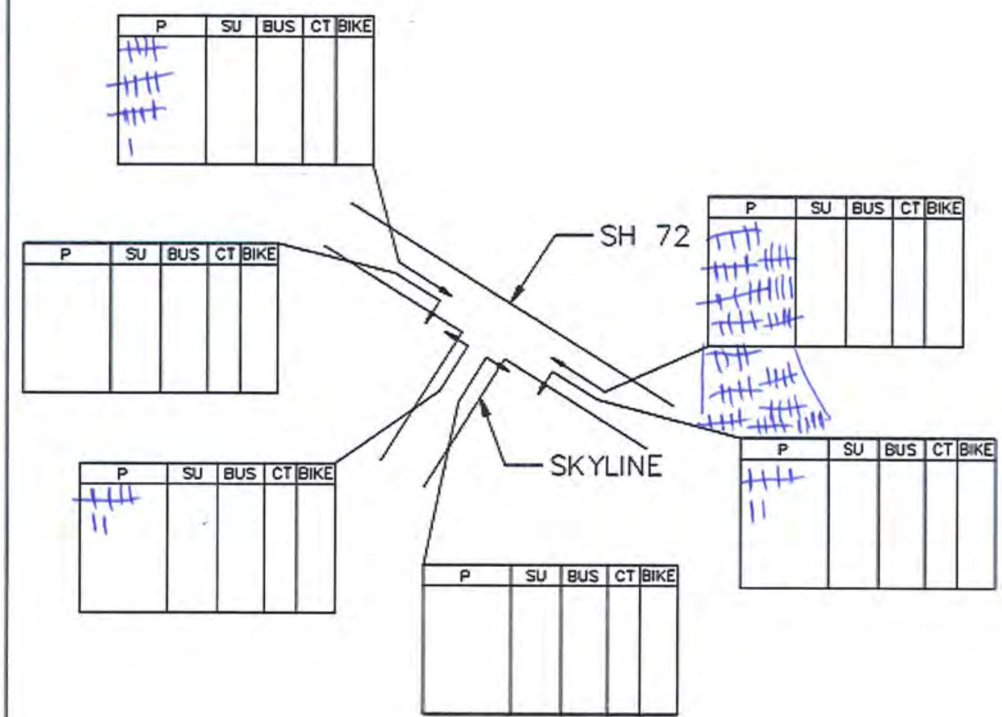


* The trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

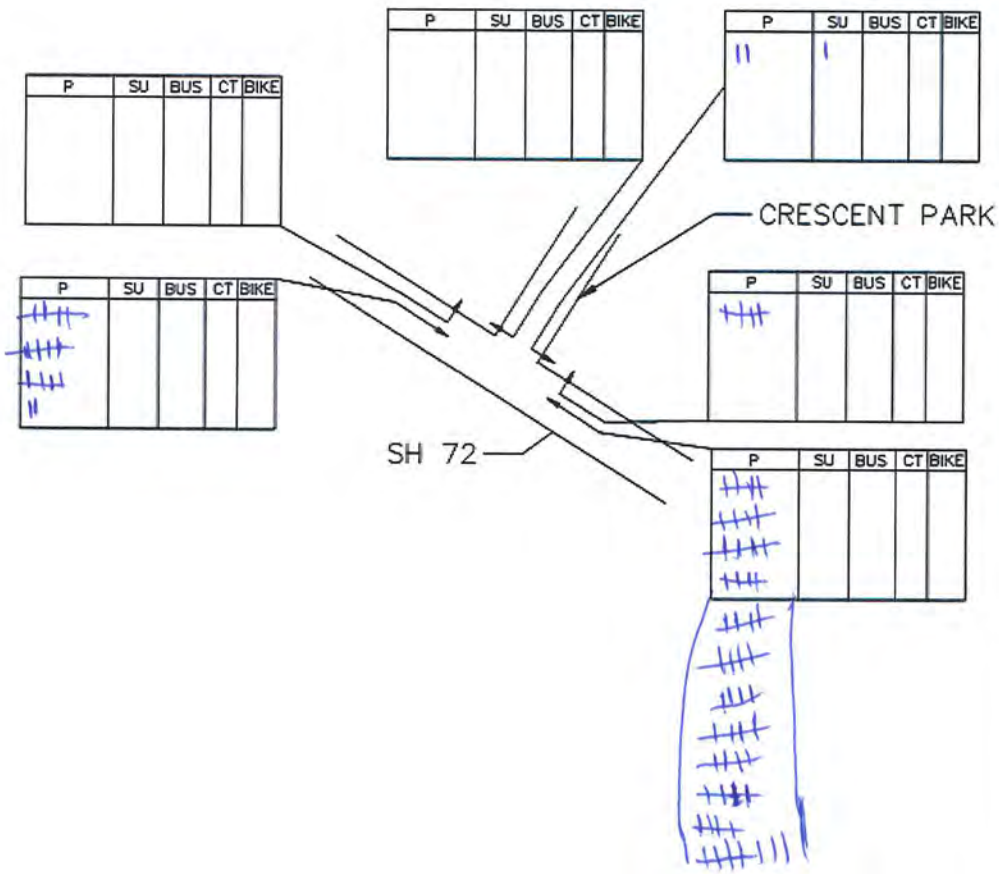
Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:30pm to 5:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

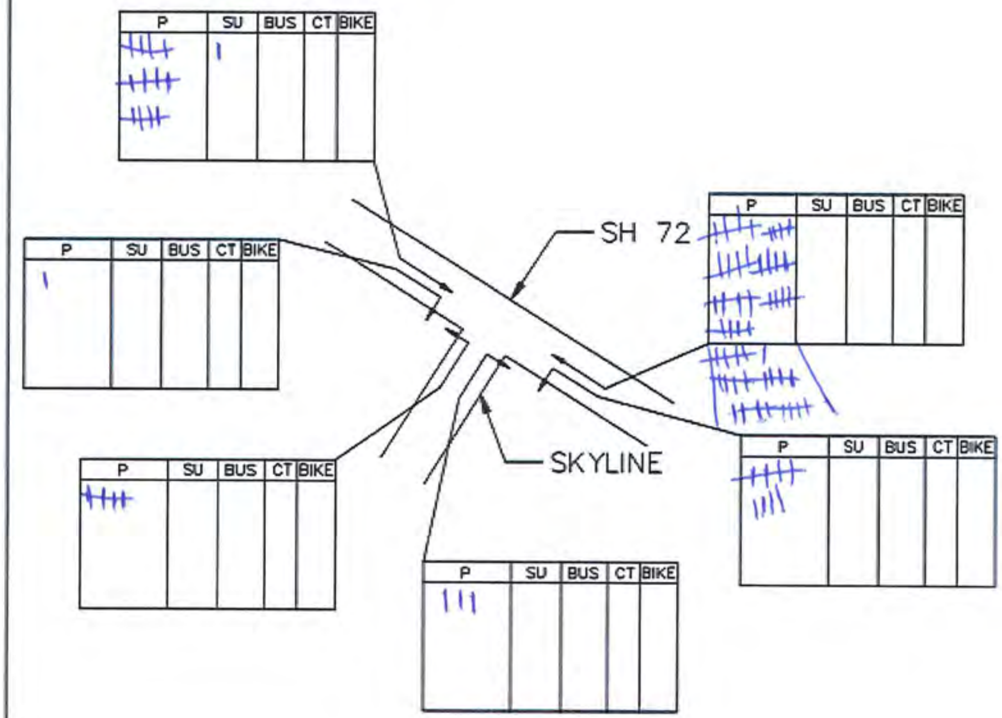

P SU BUS CT BIKE
CRESCENT PARK
SH 72


P SU BUS CT BIKE
SH 72
SKYLINE

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Crescent Park and Skyline Drive
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:45pm to 6:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)


P SU BUS CT BIKE
CRESCENT PARK
SH 72


P SU BUS CT BIKE
SH 72
SKYLINE

Intersection:	Gross Dam Road and Crescent Park Drive

Time Increment	Gross Dam Road				Crescent Park		Total
	Left SB	Through SB	Through NB	Right NB	Left SB	Right NB	
9-9:15	3	0	0	1	1	0	5
9:15-9:30	2	0	0	1	0	2	5
9:30-9:45	1	0	0	0	1	3	5
9:45-10	1	0	0	0	0	0	1
10-10:15	0	1	0	1	1	1	4
10:15-10:30	5	0	0	0	0	2	7
10:30-10:45	2	0	1	1	0	0	4
10:45-11	1	0	0	0	0	0	1

Time Increment	Gross Dam Road				Crescent Park		Total	
	Left SB	Through SB	Through NB	Right NB	Left SB	Right NB		
4-4:15	3	0	1	2	3	1	10	Counted the bus U-turn as a right onto Crescent Park and a left onto Gross Dam
4:15-4:30	1	0	1	2	2	0	6	
4:30-4:45	2	0	0	1	2	2	7	Counted the passenger vehicle U-turn as a right onto Gross Dam and a left onto Crescent Park
4:45-5	1	0	0	2	0	2	5	
5-5:15	1	1	0	0	3	1	6	
5:15-5:30	1	0	0	1	1	4	7	
5:30-5:45	0	0	0	0	2	3	5	
5:45-6	1	0	0	0	1	0	2	

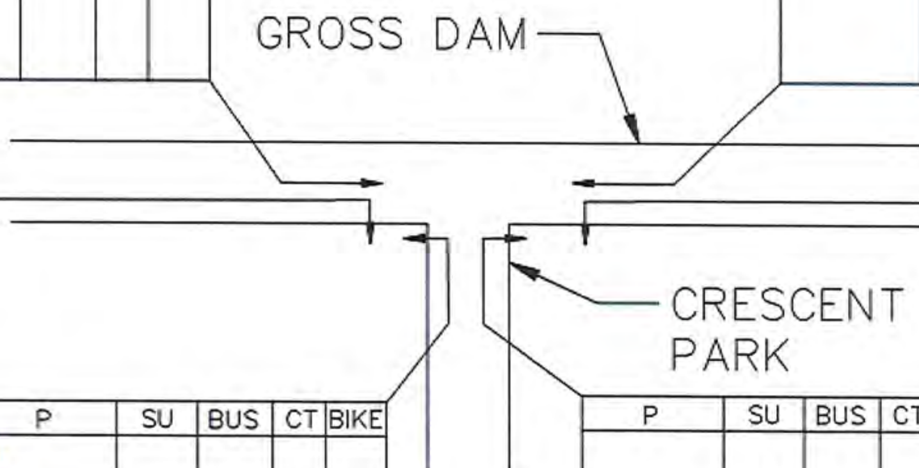
Indicates peak hour

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:00am to 9:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE
III				

P	SU	BUS	CT	BIKE
I				

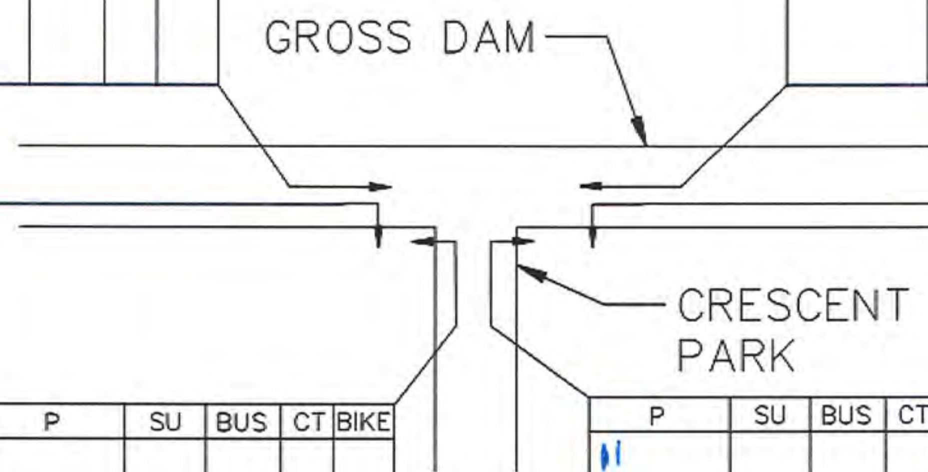
P	SU	BUS	CT	BIKE

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:15am to 9:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE
II				

P	SU	BUS	CT	BIKE

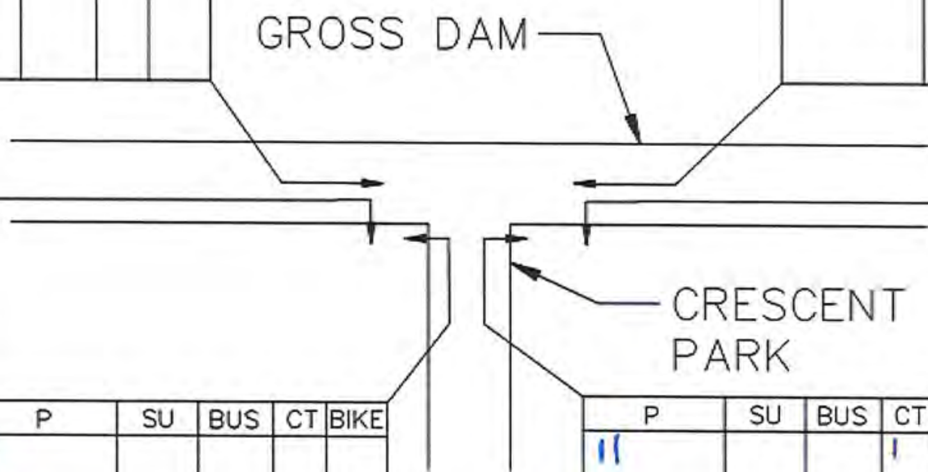
P	SU	BUS	CT	BIKE
II				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:30am to 9:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE

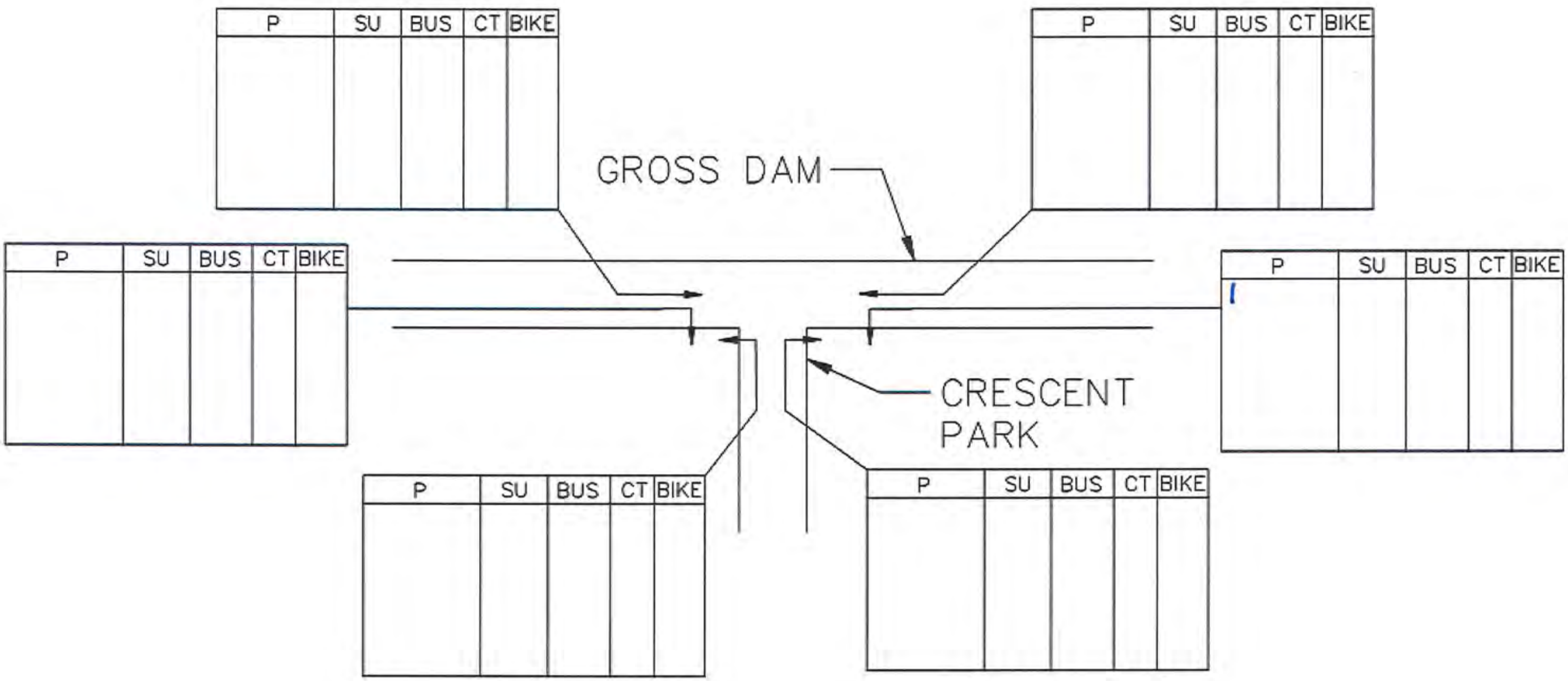
P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE
II			I	

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 9:45am to 10:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)



P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE

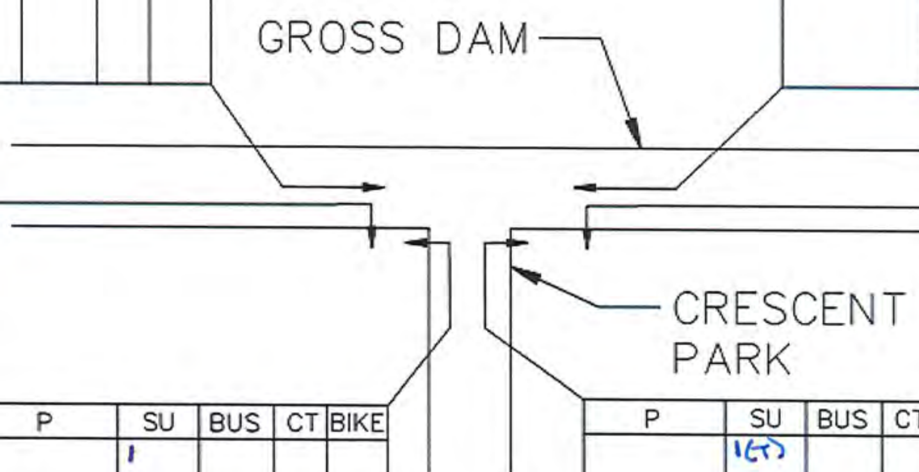
P	SU	BUS	CT	BIKE

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:00am to 10:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
1				1



P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
	1			

P	SU	BUS	CT	BIKE
	1(T)			

↑
TURNED RIGHT ONTO GDR, THEN BACKED THROUGH INTERSECTION AND PARKED ~200' WEST OF INTERSECTION (DUMPTRUCK WITH TRAILER)

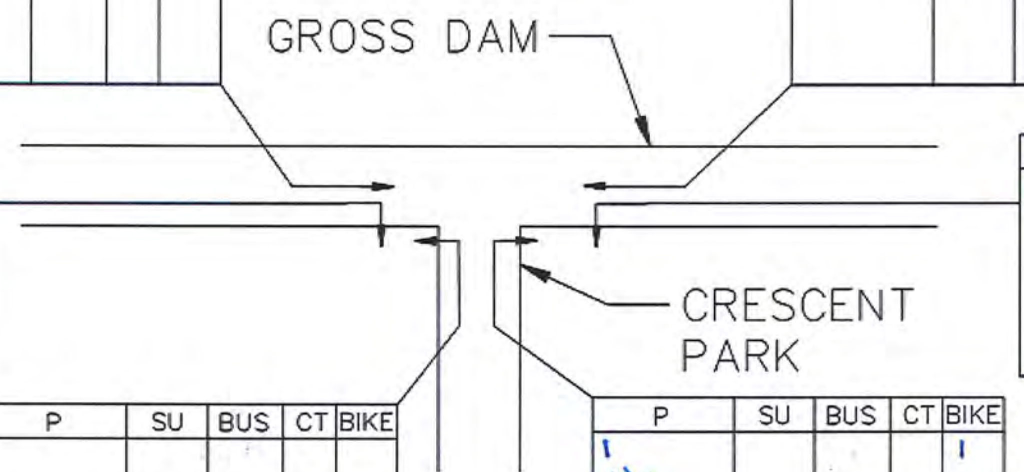
* The trailer ticks indicate ~~pass~~ vehicles w/ trailers and are not double marked under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:15am to 10:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
				1

P	SU	BUS	CT	BIKE
卌				

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
1 (T) 1				1

* The trailer ticks indicate vehicles w/ trailers and are 'not' 'double' marked under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

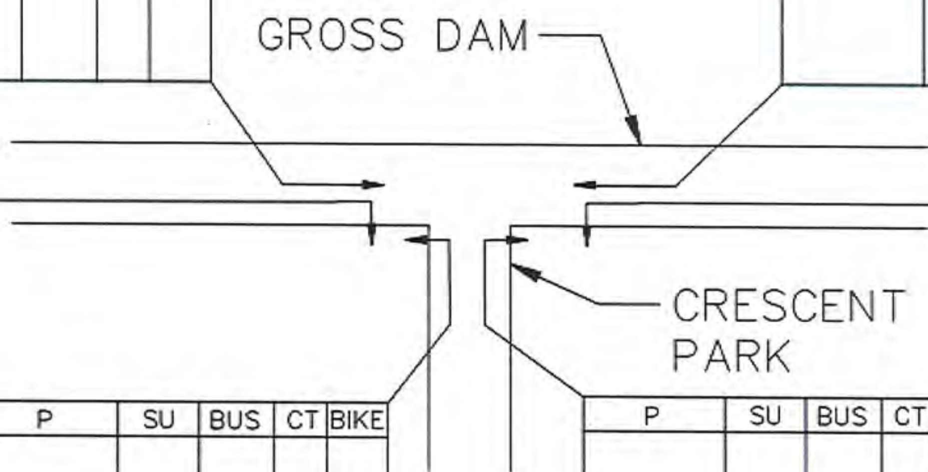
Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:30am to 10:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE
II				



P	SU	BUS	CT	BIKE

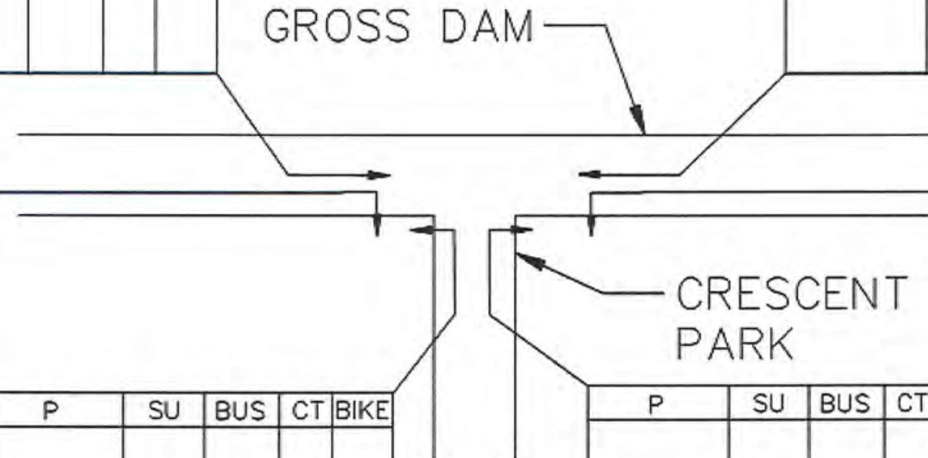
P	SU	BUS	CT	BIKE

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:45am to 11:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
			1	

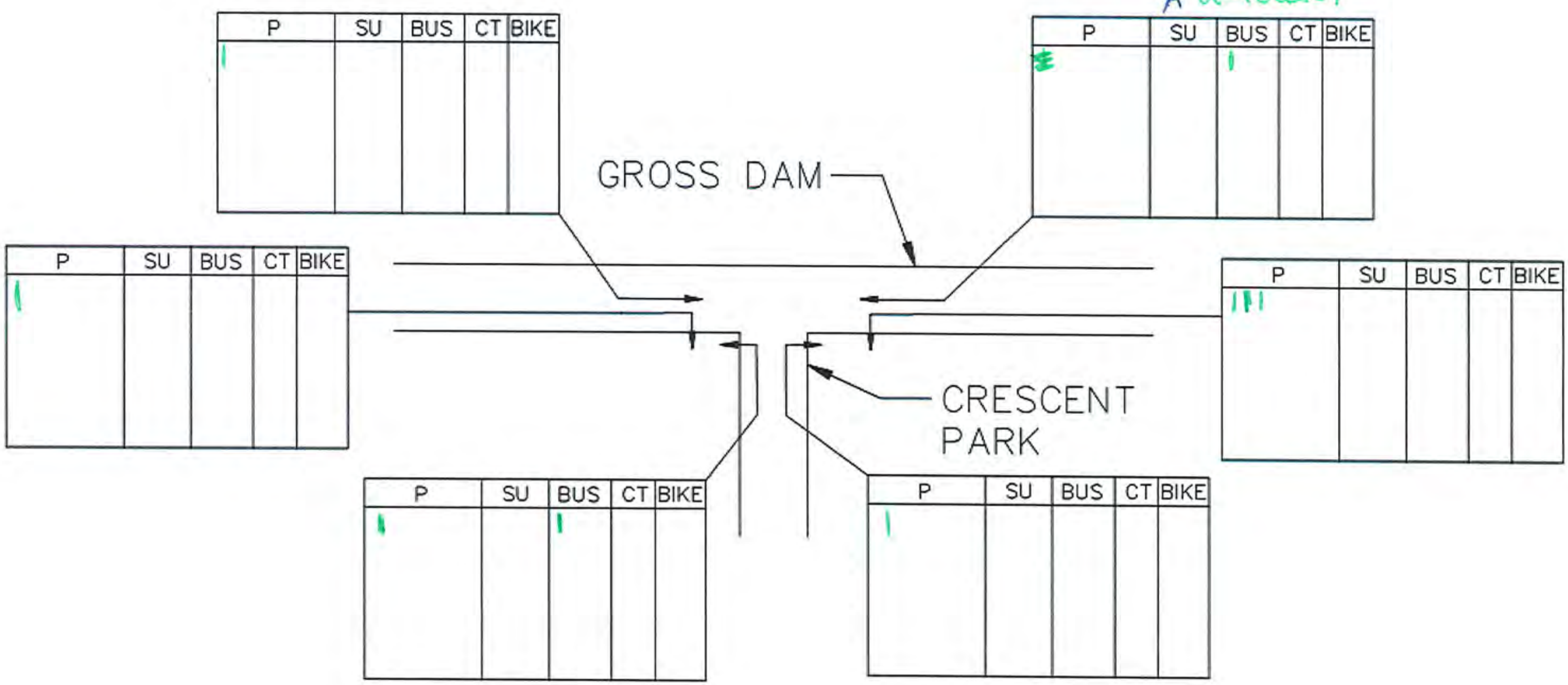
P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:00pm to 4:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

1 PASSENGER & BUS LEFT FOR SCHOOL PICKUP/DROP OFF (BUS ACTUALLY MADE A U-TURN)



P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE
[illegible]		1		

P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE
III				

P	SU	BUS	CT	BIKE
1		1		

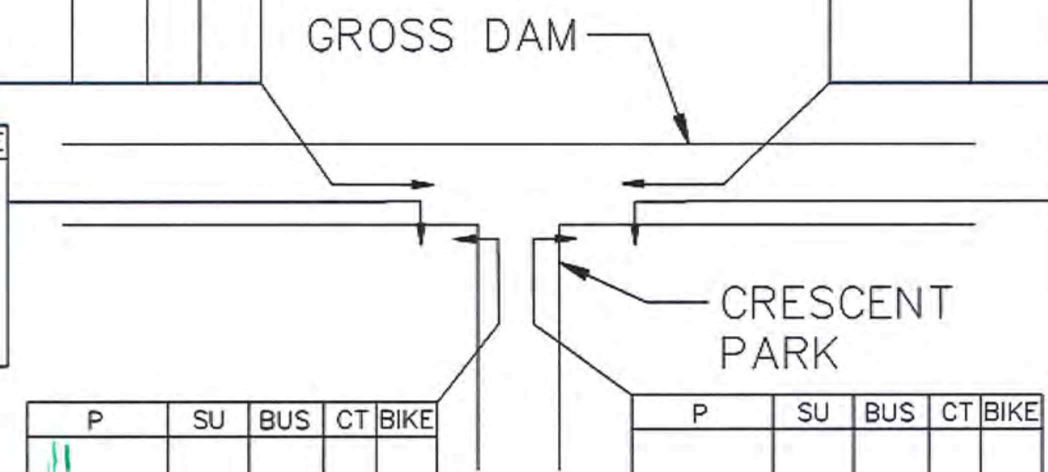
P	SU	BUS	CT	BIKE
1				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:15pm to 4:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
	|			

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
||				

P	SU	BUS	CT	BIKE
|				

P	SU	BUS	CT	BIKE
||				

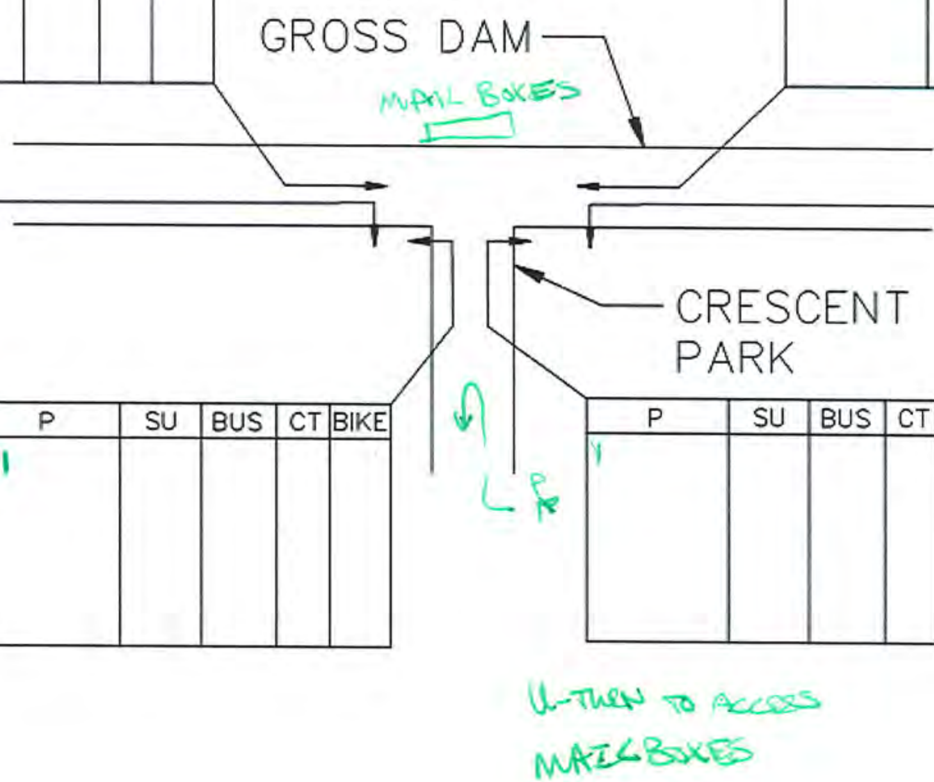
P	SU	BUS	CT	BIKE

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:30pm to 4:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE
	1			

P	SU	BUS	CT	BIKE
11				

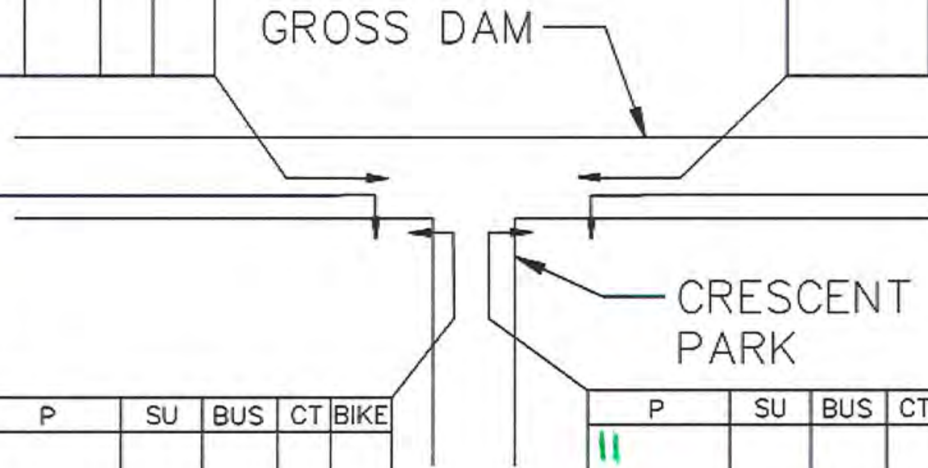
P	SU	BUS	CT	BIKE
1				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 4:45pm to 5:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
II				

P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE

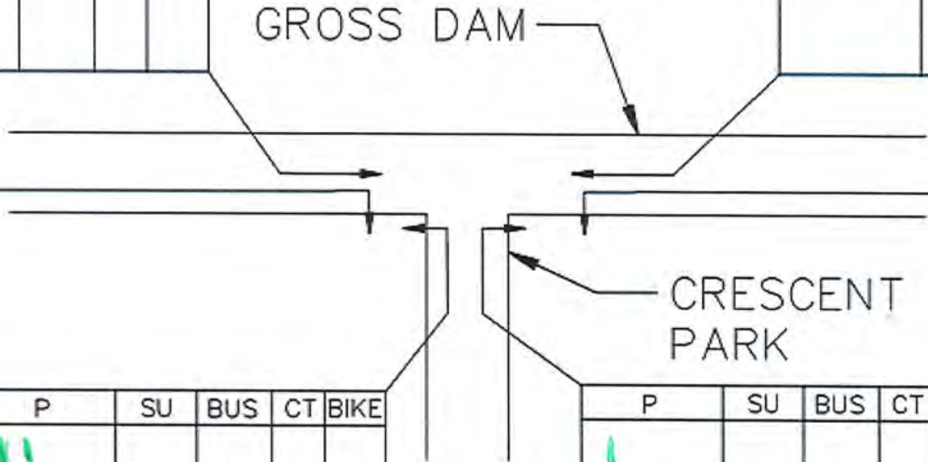
P	SU	BUS	CT	BIKE
II				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:00pm to 5:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
I				



P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
I				

RED
I

P	SU	BUS	CT	BIKE
III I				

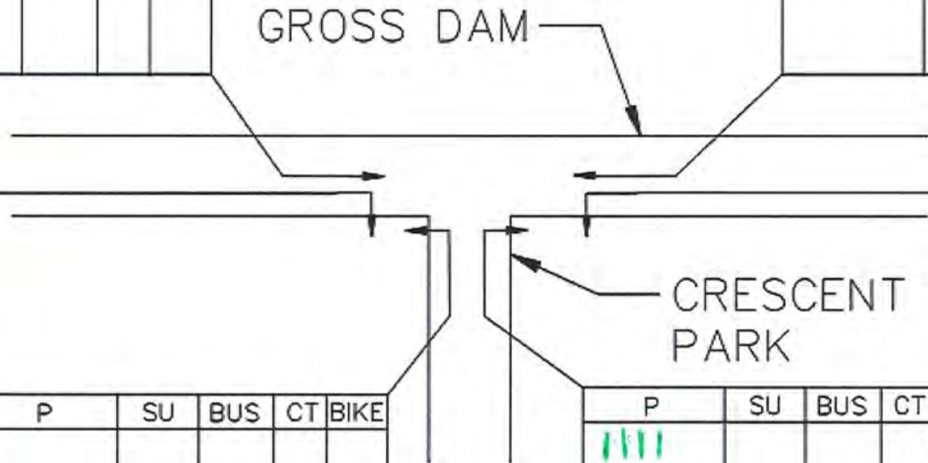
P	SU	BUS	CT	BIKE
I				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:15pm to 5:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
|				

P	SU	BUS	CT	BIKE
|				

P	SU	BUS	CT	BIKE
|				

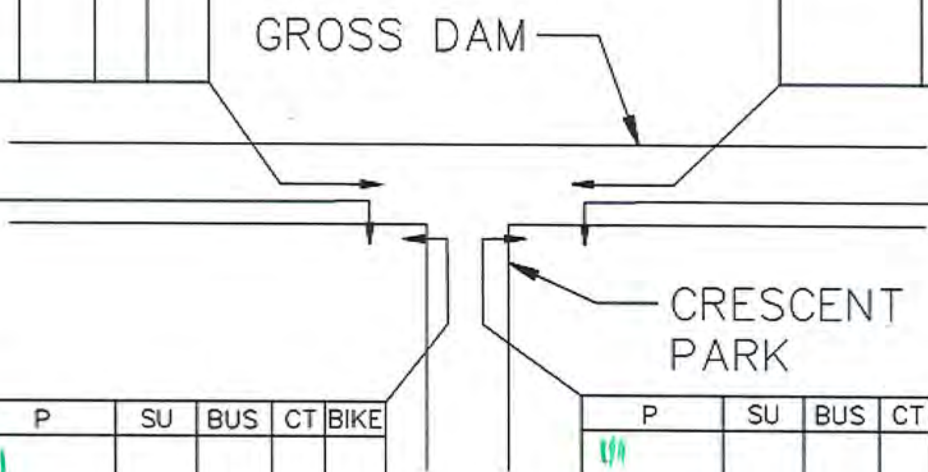
P	SU	BUS	CT	BIKE
||||				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:30pm to 5:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
||				

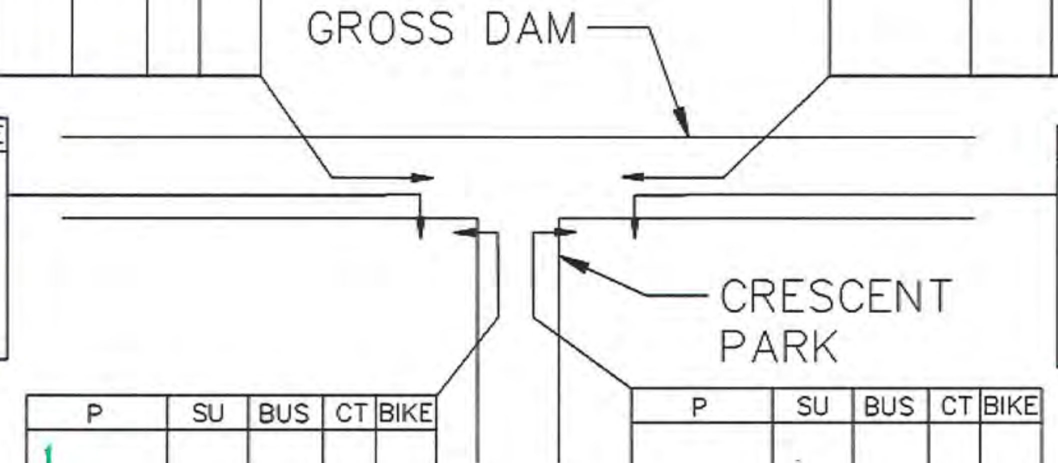
P	SU	BUS	CT	BIKE
|||				

SH 72 and Gross Dam Road Traffic Counts

Location: Gross Dam Road and Crescent Park
Date: 12/8/15
Time Period: 4-6pm
Time Increment: 5:45pm to 6:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE

Intersection:	SH 72 and Blue Mountain Road

Time Increment	SH 72				Blue Mountain		Total
	Left WB	Through WB	Through EB	Right EB	Left WB	Right EB	
9-9:15	7	21	50	0	0	9	87
9:15-9:30	1	23	43	0	1	7	75
9:30-9:45	2	16	46	0	0	10	74
9:45-10	5	23	37	0	0	7	72
10-10:15	2	21	50	0	1	5	79
10:15-10:30	3	16	51	1	0	2	73
10:30-10:45	4	16	35	0	0	4	59
10:45-11	7	14	27	0	0	6	54

Time Increment	SH 72				Blue Mountain		Total
	Left WB	Through WB	Through EB	Right EB	Left WB	Right EB	
4-4:15	8	74	32	0	0	4	118
4:15-4:30	6	53	33	0	0	4	96
4:30-4:45	5	76	26	0	0	3	110
4:45-5	5	67	48	1	0	4	125
5-5:15	7	82	20	0	0	4	113
5:15-5:30	7	72	26	1	0	7	113
5:30-5:45	8	115	29	1	0	5	158
5:45-6	9	74	23	0	0	3	109

Indicates peak hour

Intersection: SH 72 and Plainview Road

Time Increment	SH 72				Plainview		Total
	Left EB	Through WB	Through EB	Right WB	Left EB	Right WB	
9-9:15	0	28	59	0	1	0	88
9:15-9:30	0	24	50	0	0	0	74
9:30-9:45	0	18	56	3	1	0	78
9:45-10	1	28	43	1	1	0	74
10-10:15	0	21	55	0	1	1	78
10:15-10:30	0	18	53	2	1	1	75
10:30-10:45	1	20	38	0	1	0	60
10:45-11	0	20	33	2	1	1	57

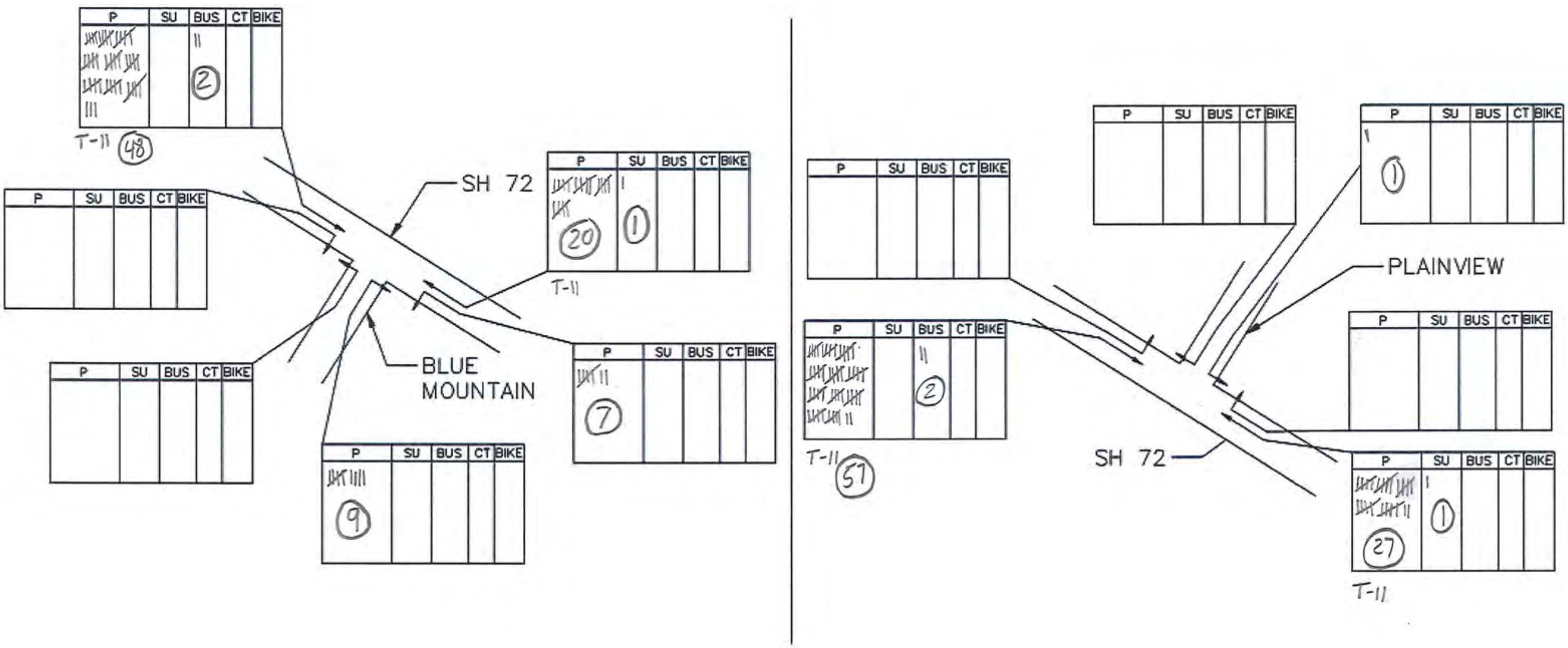
Time Increment	SH 72				Plainview		Total
	Left EB	Through WB	Through EB	Right WB	Left EB	Right WB	
4-4:15	0	70	36	2	1	2	111
4:15-4:30	2	59	35	5	4	0	105
4:30-4:45	1	79	28	3	3	2	116
4:45-5	0	71	52	3	2	1	129
5-5:15	0	87	24	2	2	2	117
5:15-5:30	0	78	33	4	1	1	117
5:30-5:45	0	121	34	0	0	2	157
5:45-6	0	82	26	4	0	1	113

Indicates peak hour

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:00am to 9:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

9:00 - 9:15

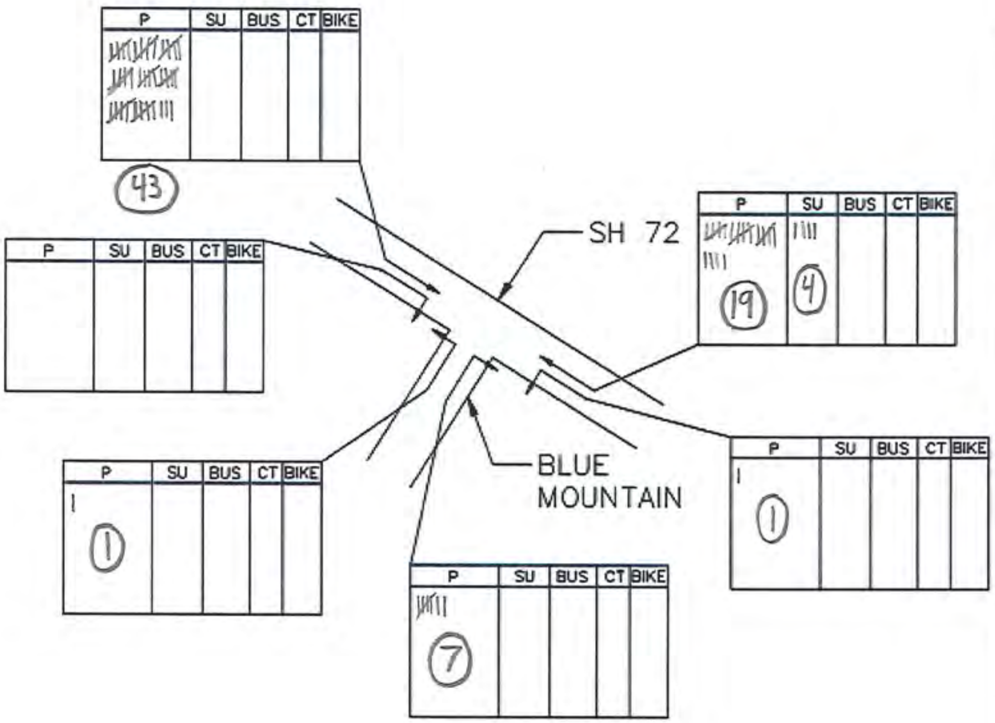


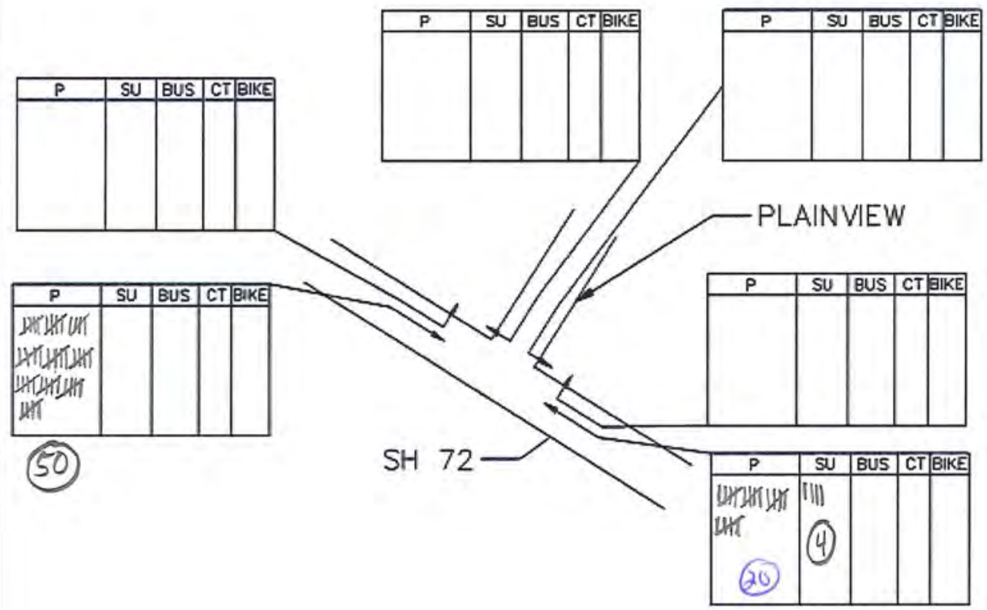
* The trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:15am to 9:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

9:15 - 9:30

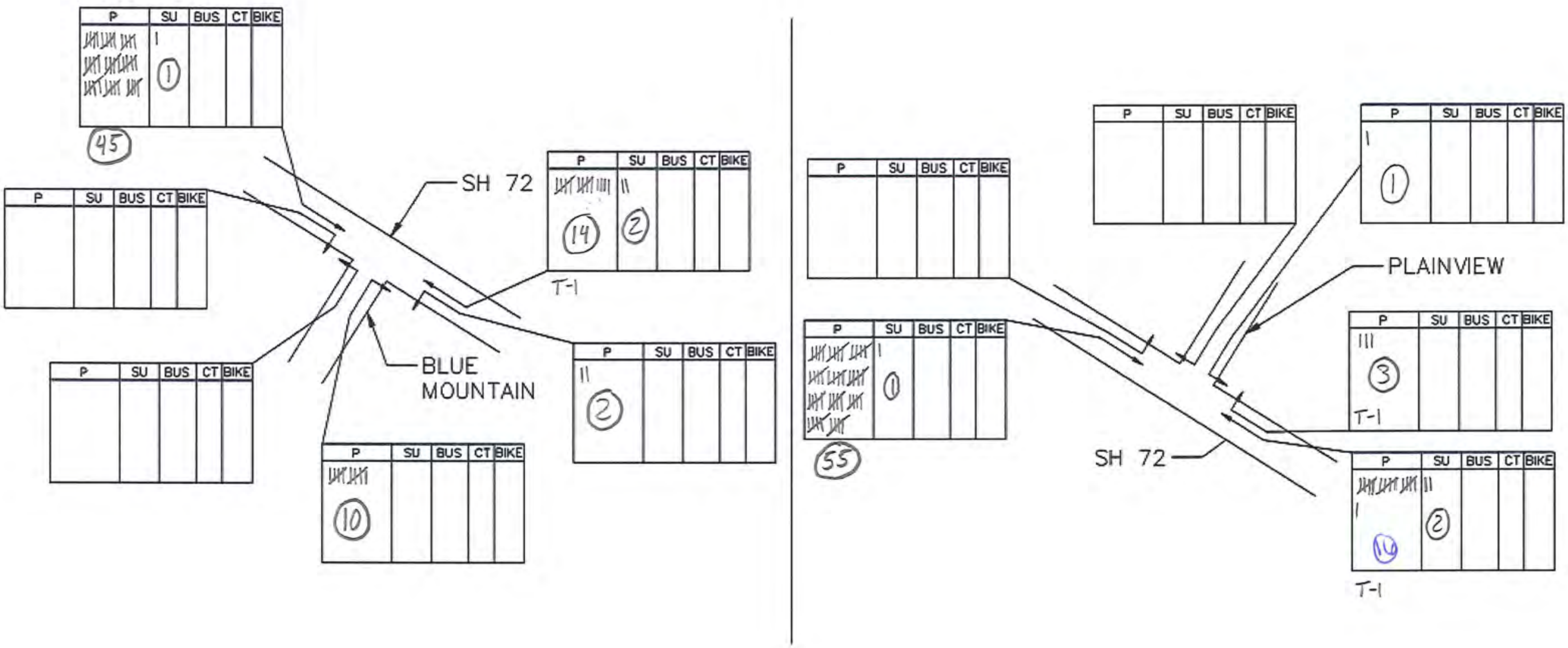

P SU BUS CT BIKE
43
SH 72
19 4
1
1
7
BLUE MOUNTAIN


P SU BUS CT BIKE
PLAINVIEW
50
SH 72
20 4

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:30am to 9:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

9:30 - 9:45

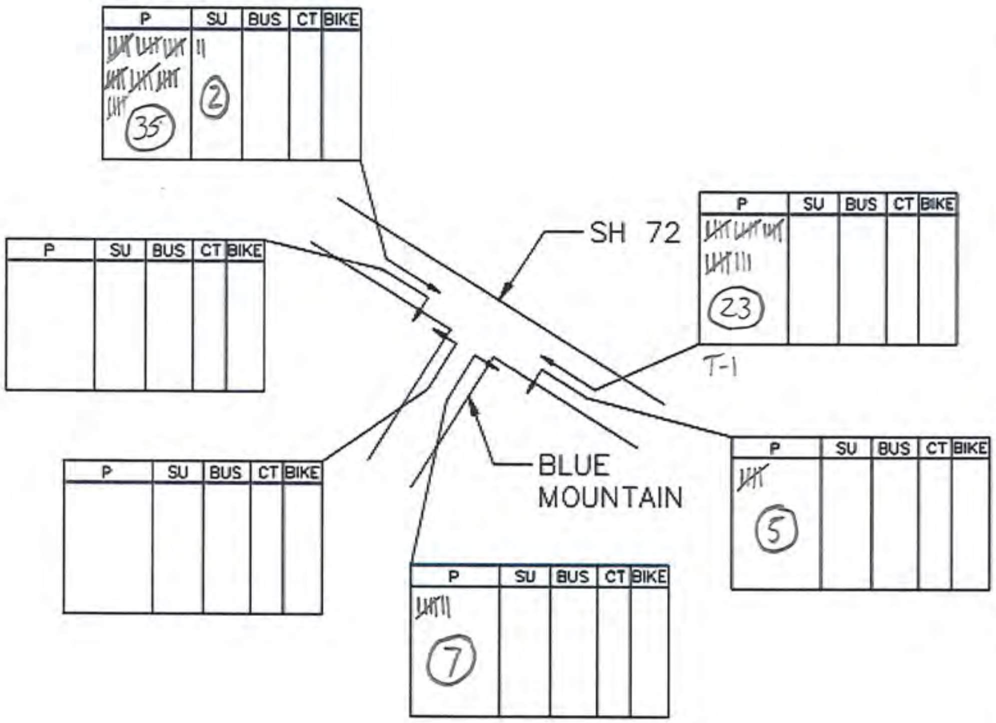


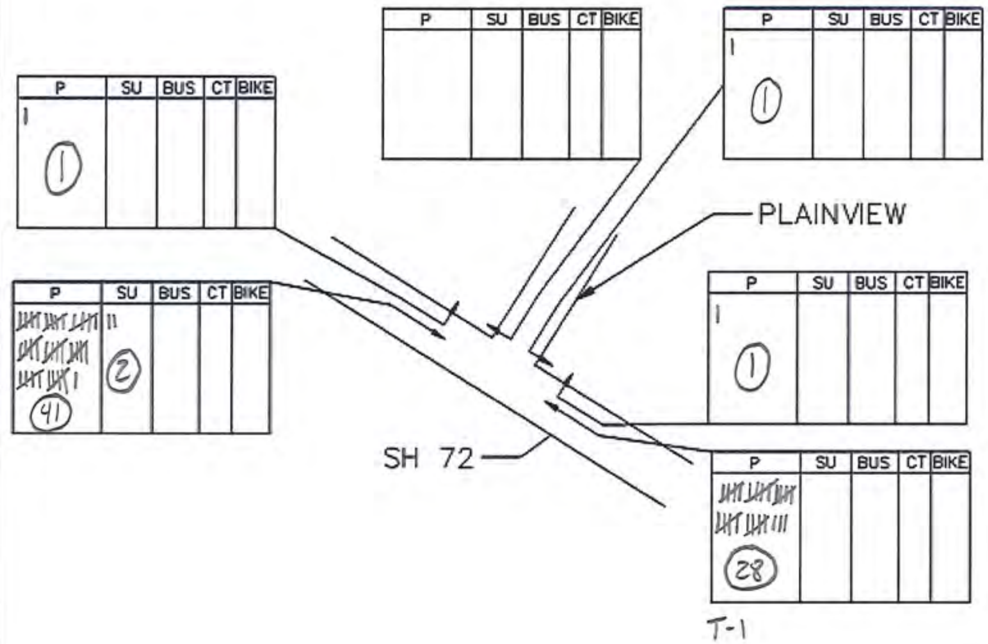
* The trailer ticks indicate the number of vehicle under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:45am to 10:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

9:45 - 10:00



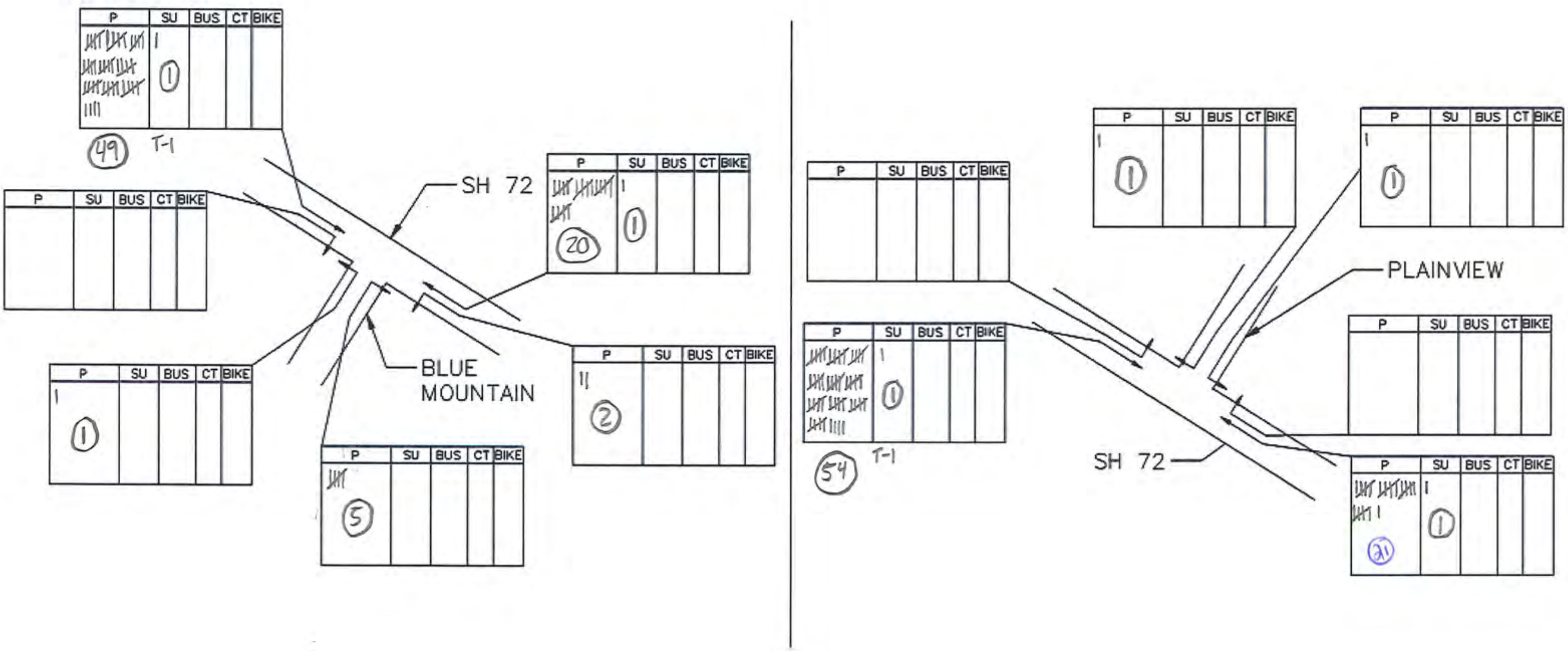


* The trailer ticks indicate the number of vehicles under the vehicle column w/ trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:00am to 10:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:00 - 10:15

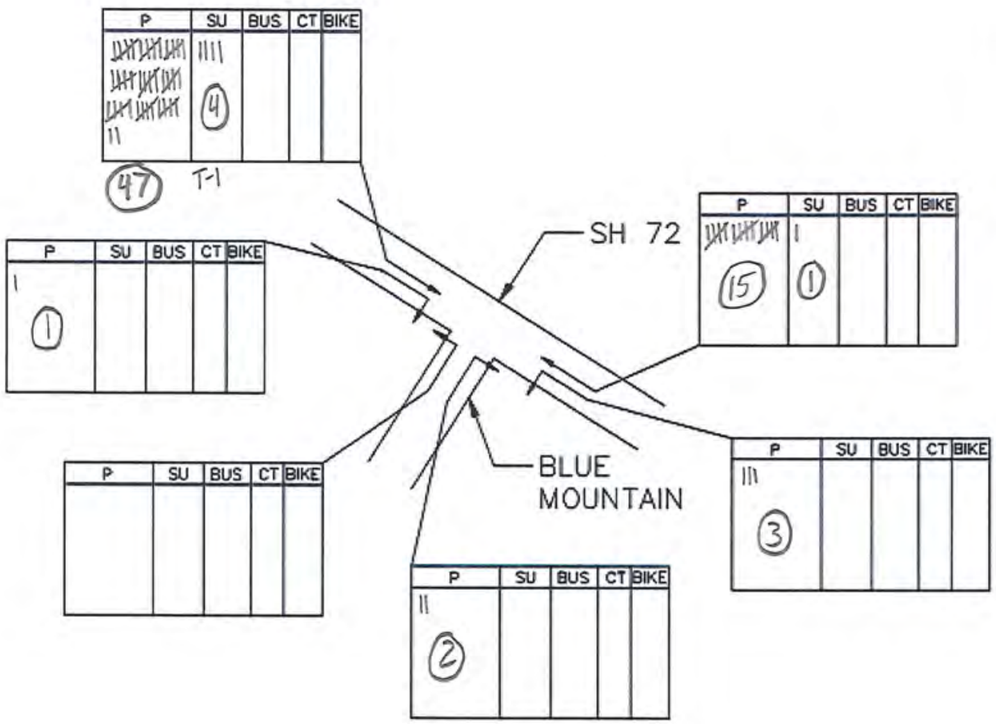


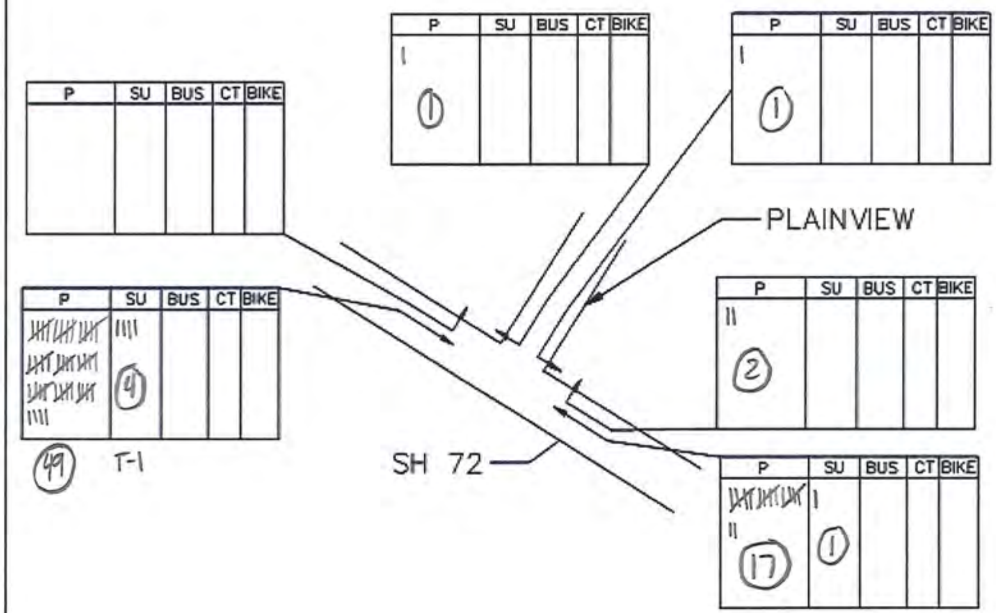
* The trailer ticks indicate the number of vehicles under the vehicle column w/ trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:15am to 10:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:15-10:30



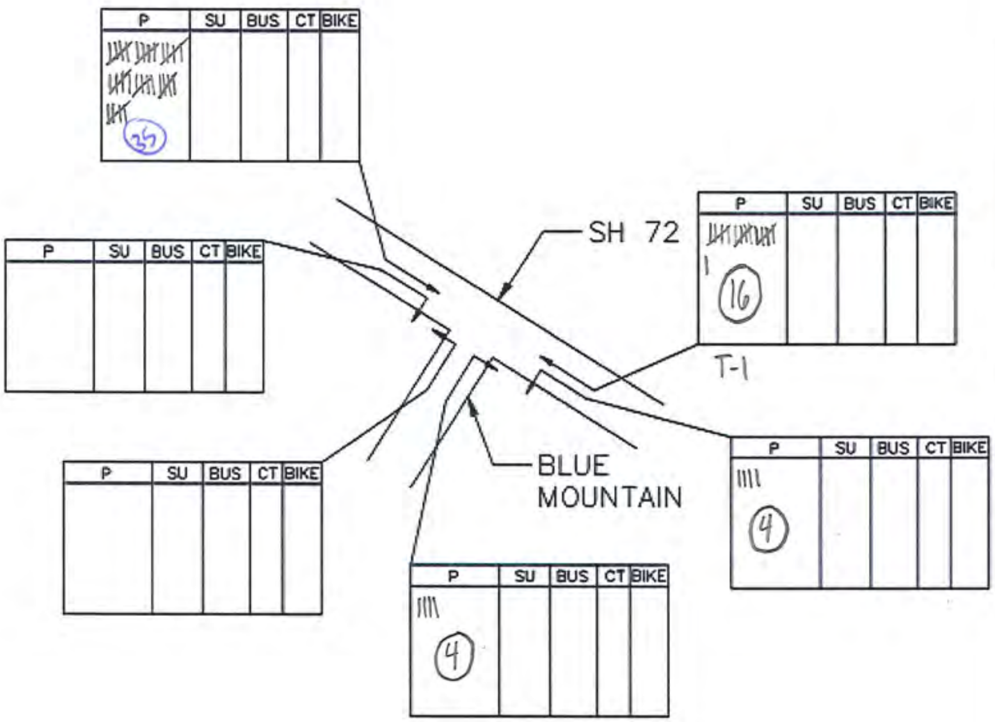


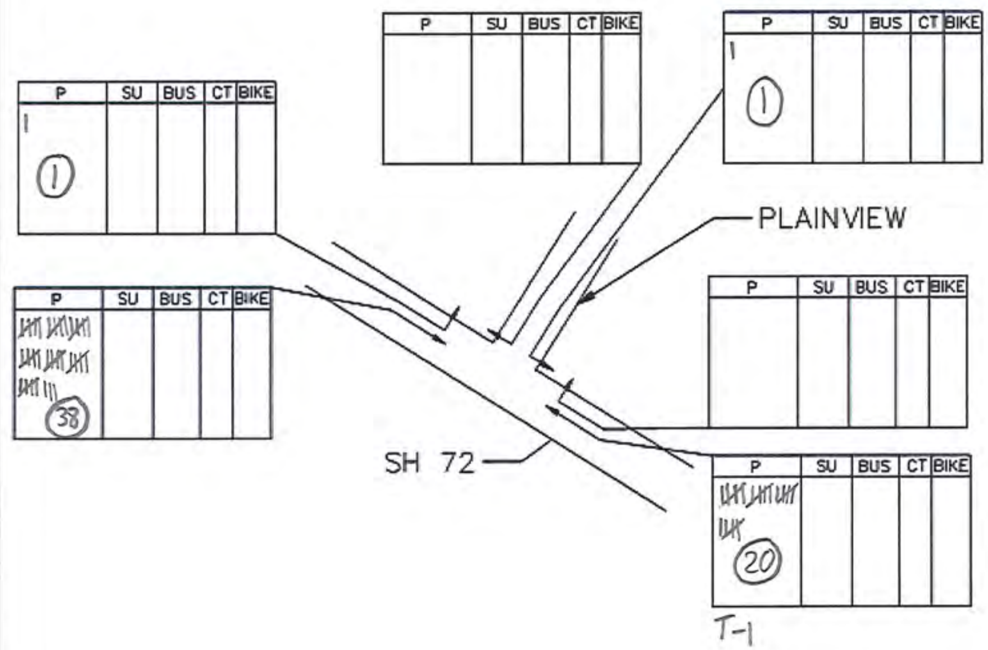
* The trailer ticks indicate the number of vehicles under the vehicle column w/ trailers and one double ~~[illegible]~~ marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:30am to 10:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:30 - 10:45



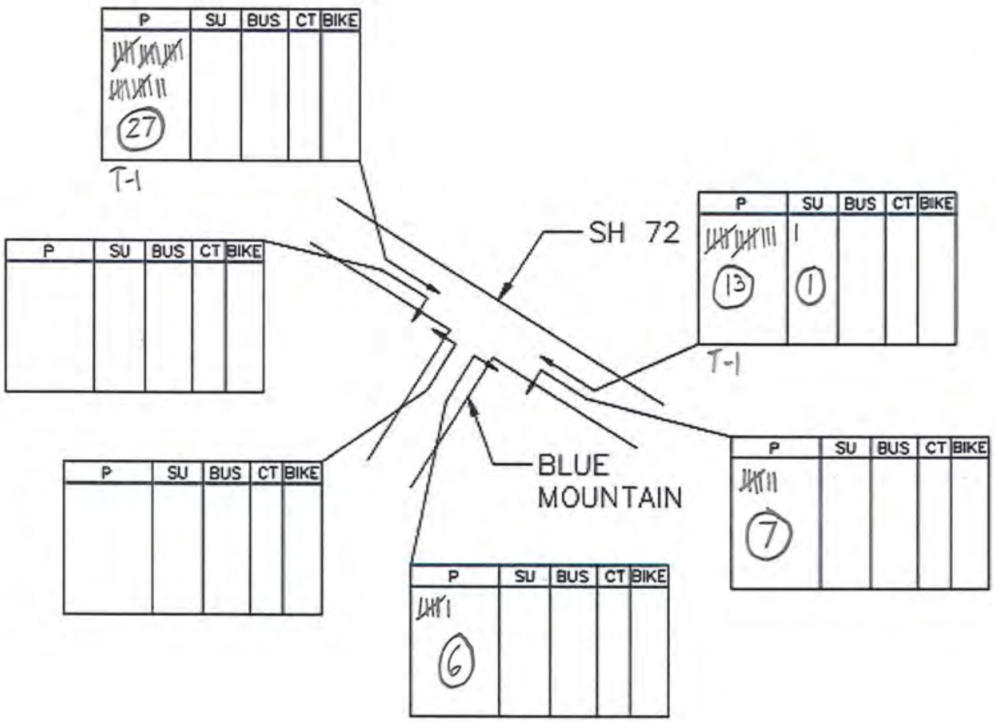


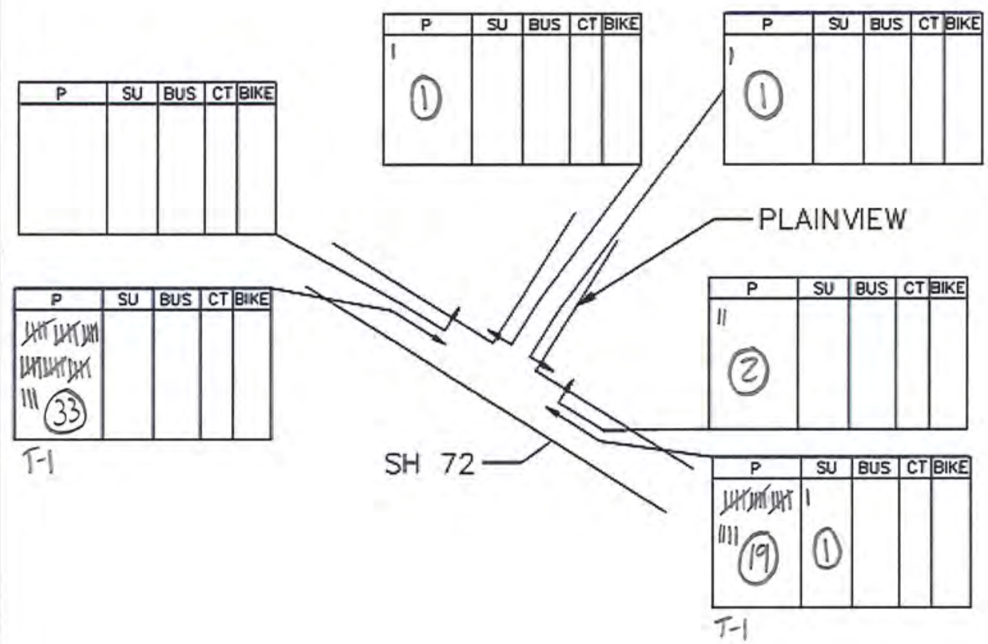
* The trailer ticks indicate the number of vehicles under the vehicle column w/trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:45am to 11:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

10:45 - 11:00



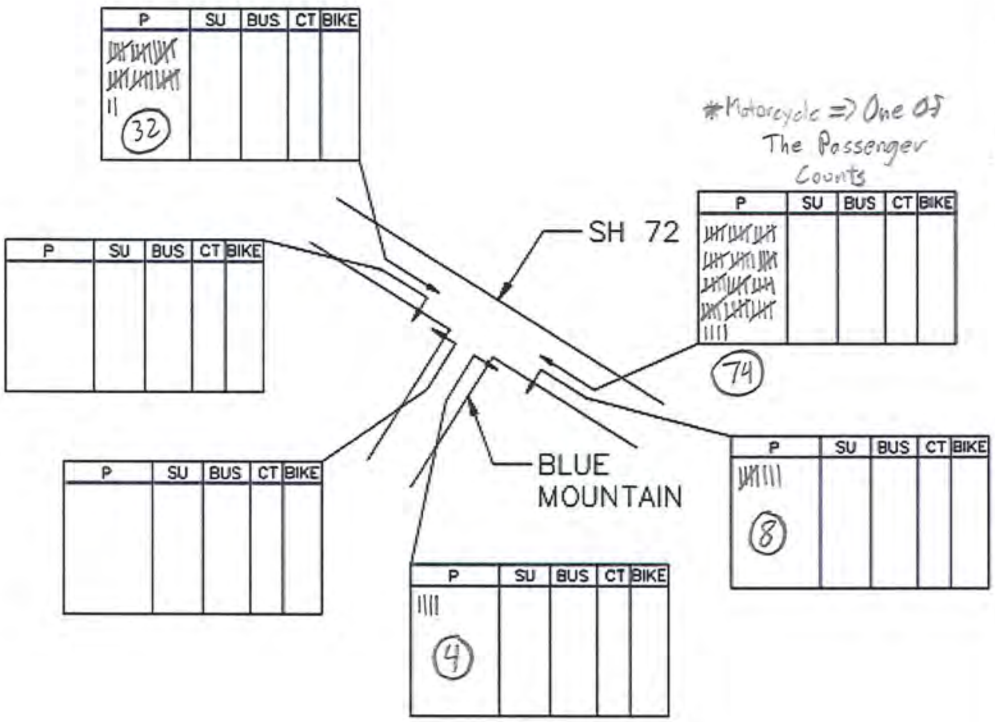


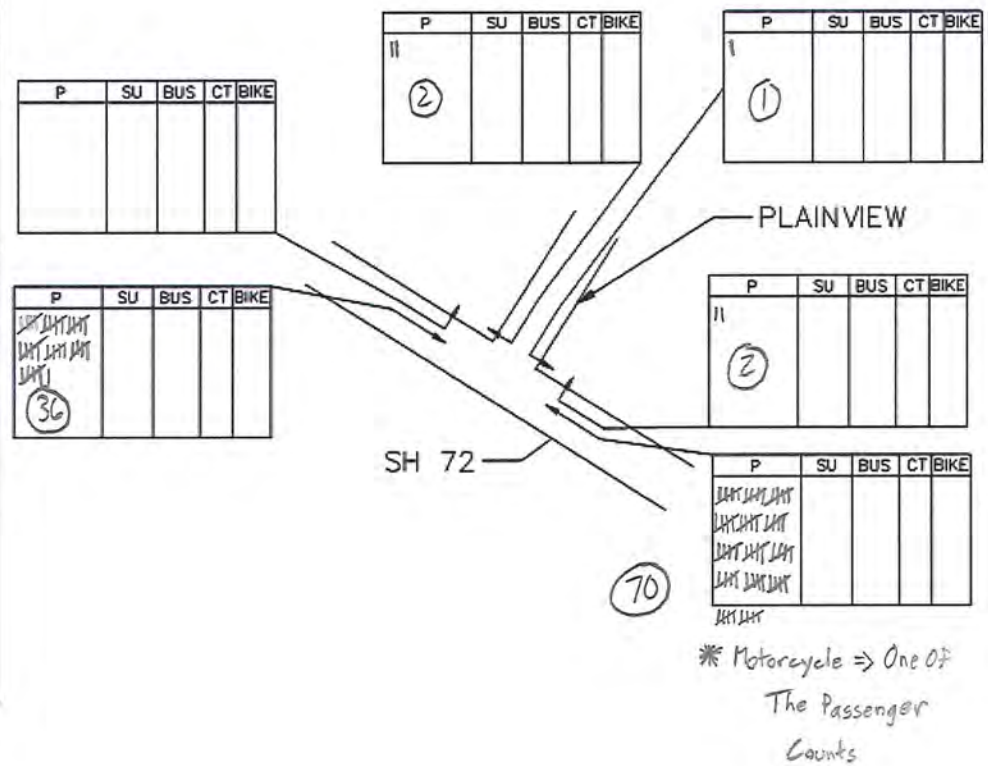
* The trailer ticks indicate the number of vehicles under the vehicle column w/ trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:00pm to 4:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

4:00-4:15

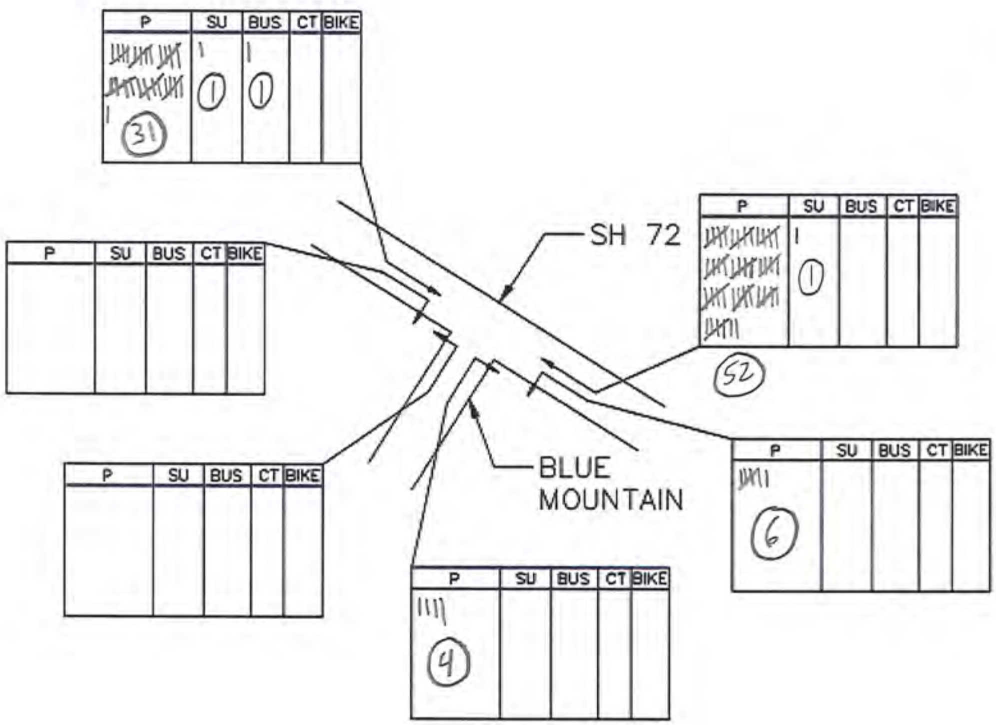

P
SU
BUS
CT
BIKE
32
*Motorcycle => One Of The Passenger Counts
74
SH 72
BLUE MOUNTAIN
4
8

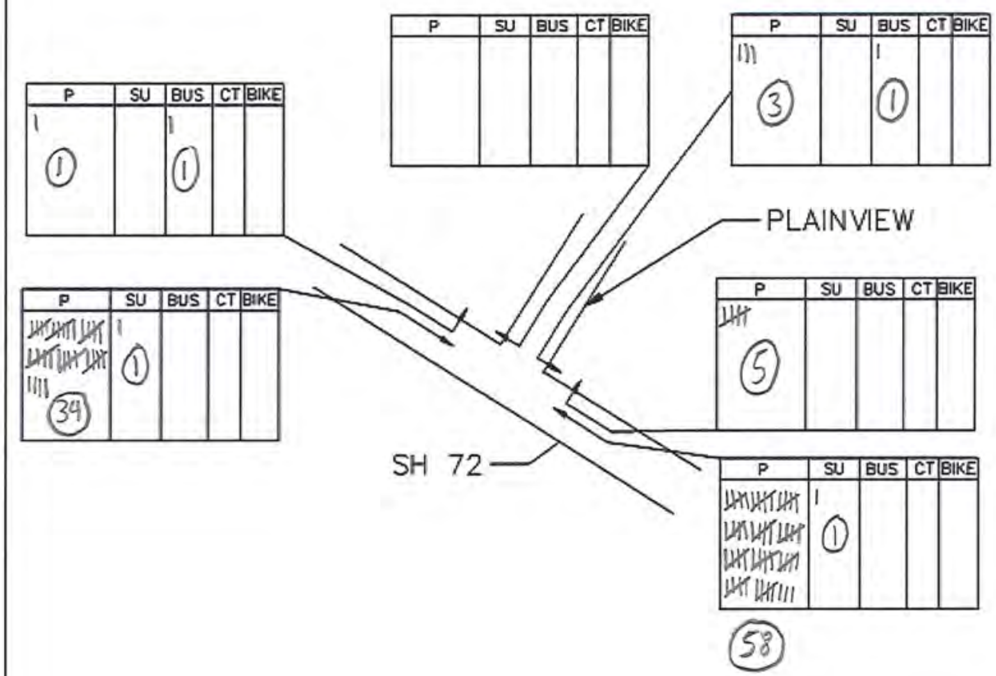

P
SU
BUS
CT
BIKE
2
1
PLAINVIEW
36
2
SH 72
70
*Motorcycle => One Of The Passenger Counts

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:15pm to 4:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

4:15 - 4:30

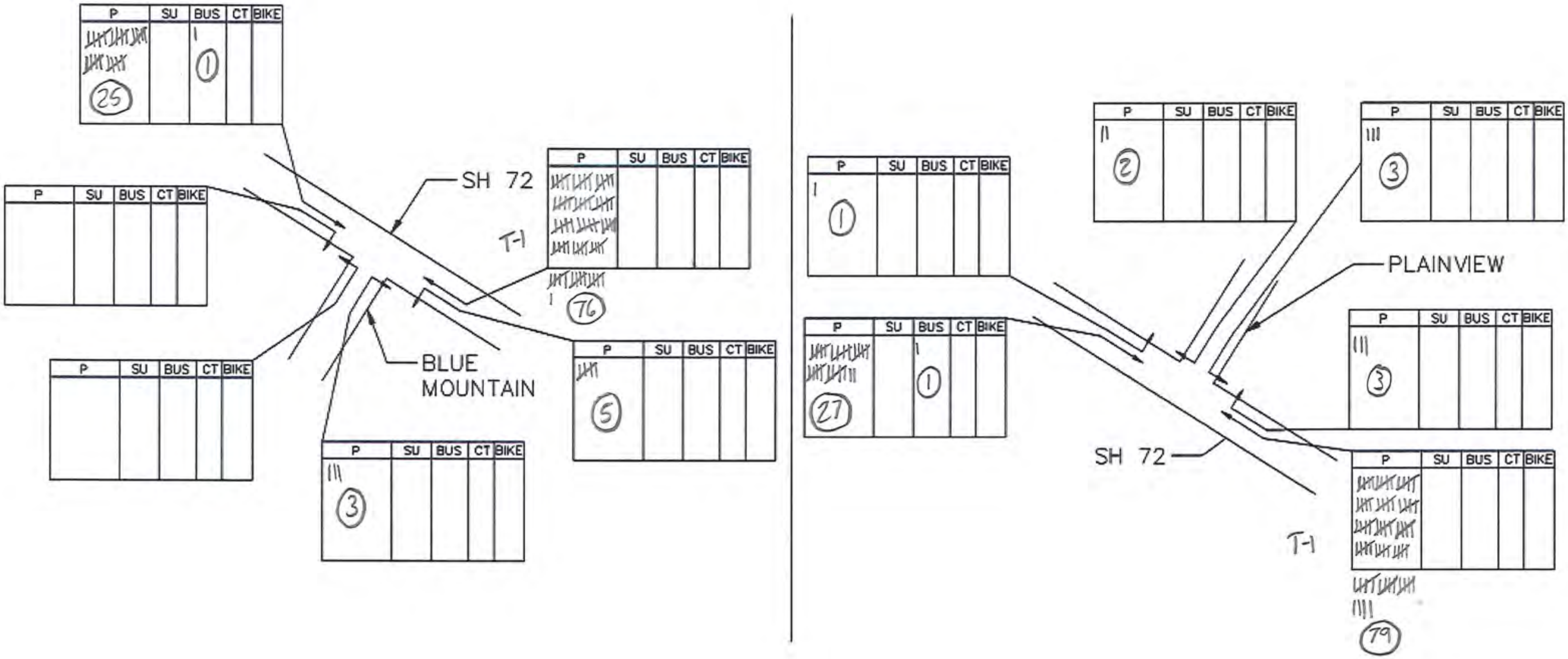

P SU BUS CT BIKE
31
1
1
P SU BUS CT BIKE
SH 72
P SU BUS CT BIKE
52
1
P SU BUS CT BIKE
BLUE
MOUNTAIN
P SU BUS CT BIKE
6
P SU BUS CT BIKE
4


P SU BUS CT BIKE
1
1
P SU BUS CT BIKE
P SU BUS CT BIKE
3
1
PLAINVIEW
P SU BUS CT BIKE
34
1
P SU BUS CT BIKE
5
SH 72
P SU BUS CT BIKE
58
1

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:30pm to 4:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

4:30 - 4:45

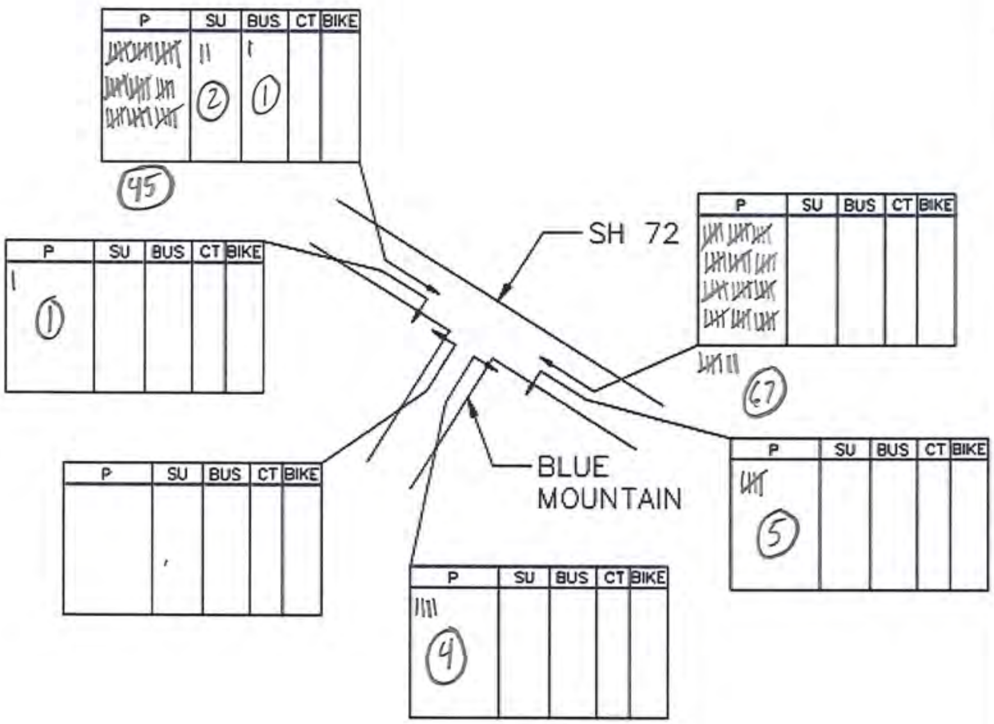


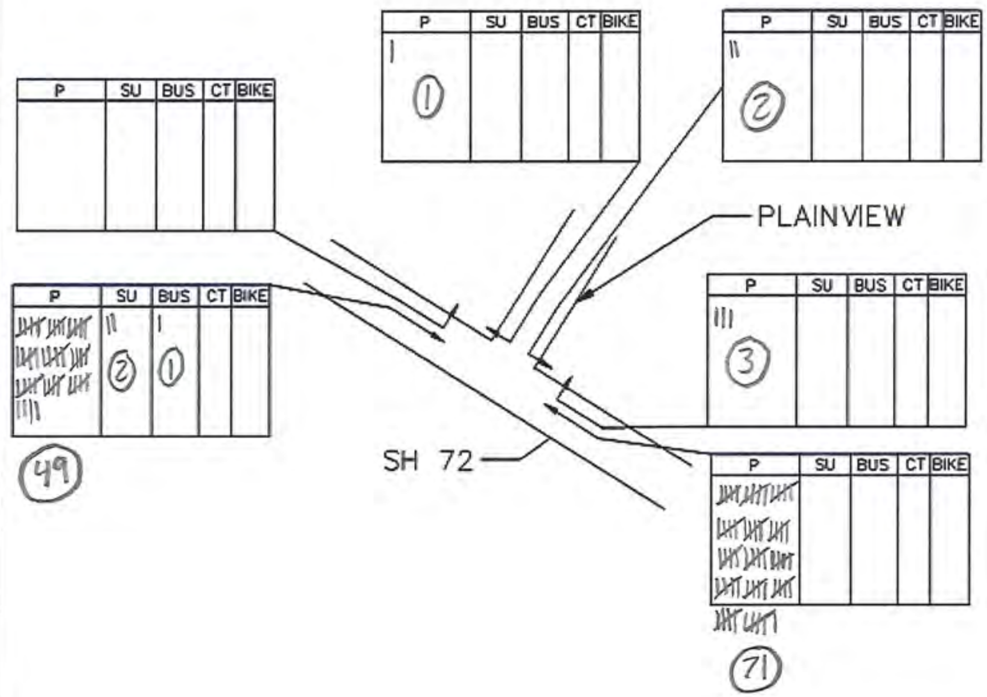
* The trailer ticks indicate the number of vehicles under the vehicle column, with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:45pm to 5:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

4:45 - 5:00

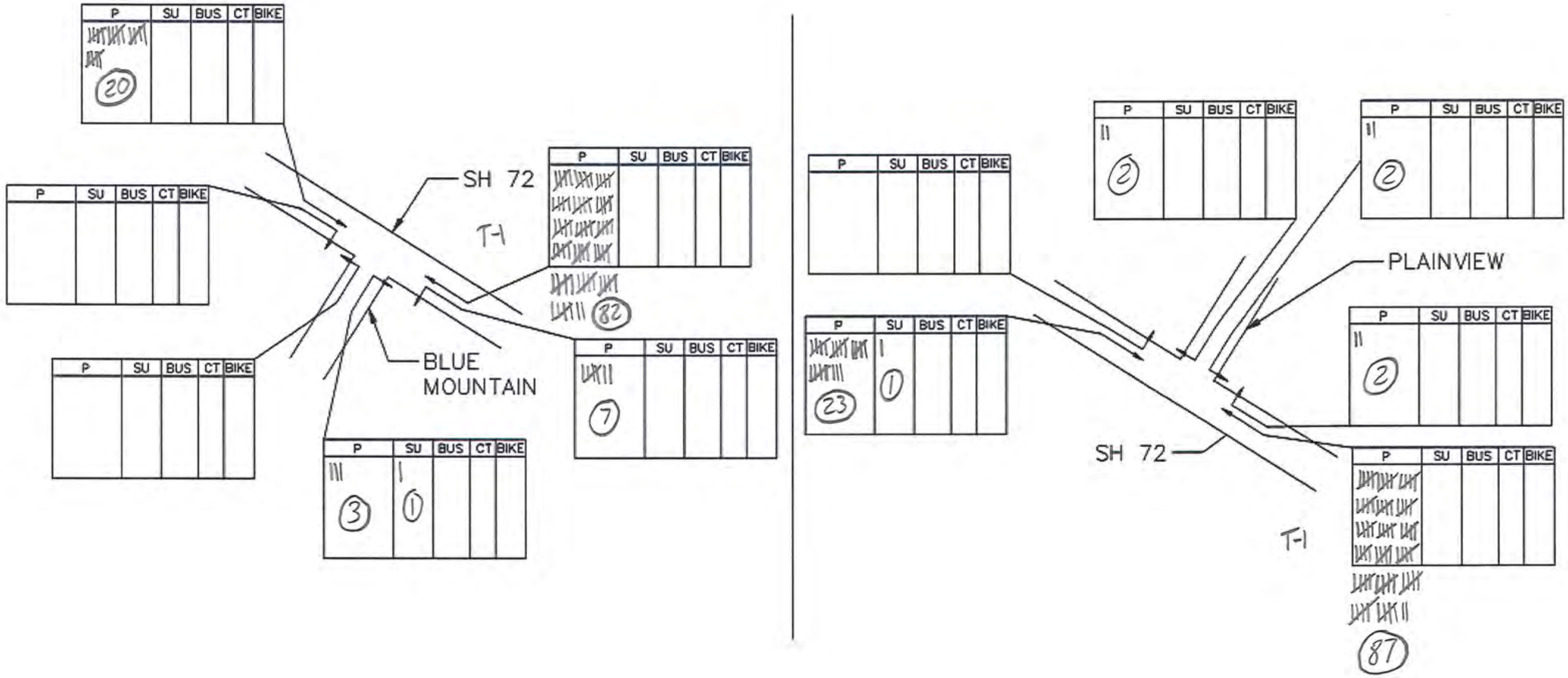

SH 72
BLUE
MOUNTAIN
P SU BUS CT BIKE
45
2
1
1
67
5
4


PLAINVIEW
SH 72
P SU BUS CT BIKE
1
2
3
49
2
1
71

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 5:00pm to 5:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

5:00-5:15

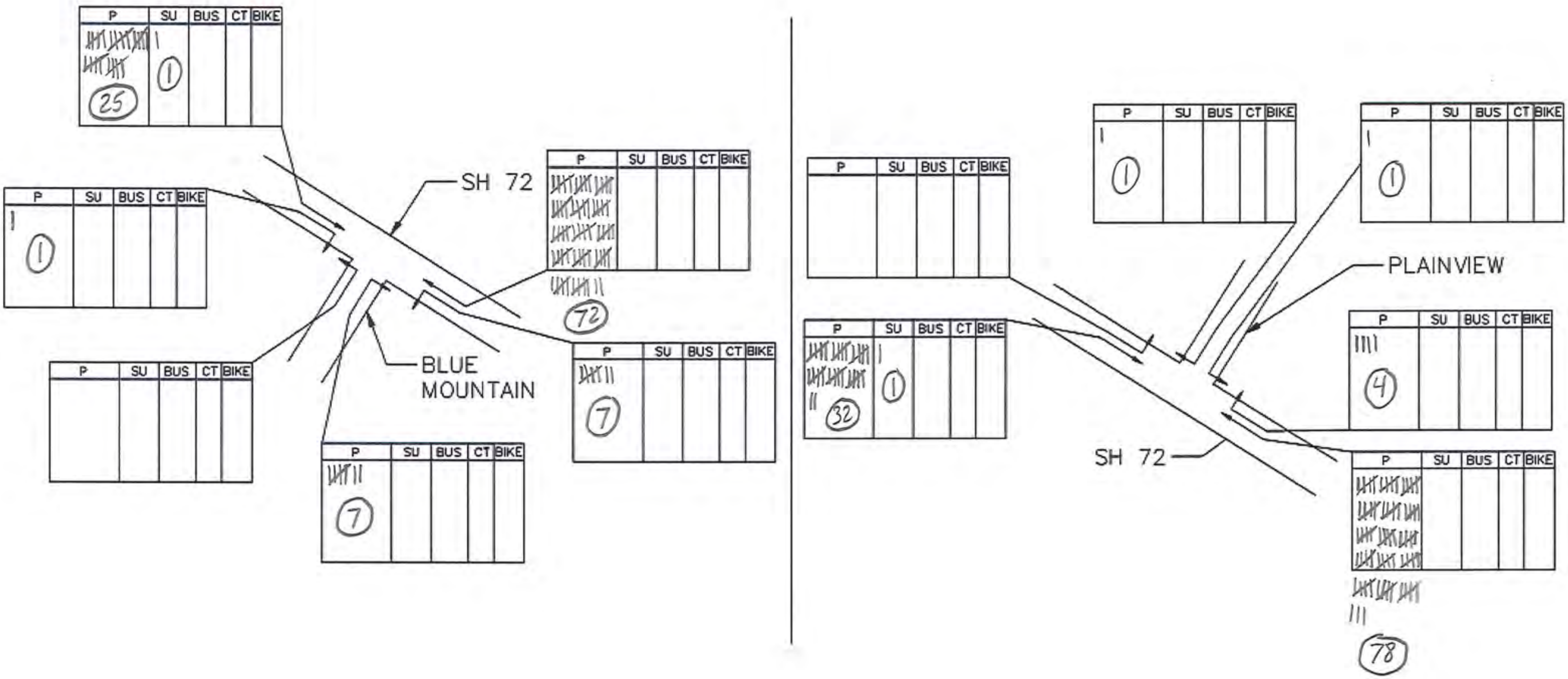


* The trailer ticks indicate the number of vehicles under the vehicle column w/ trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 5:15pm to 5:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

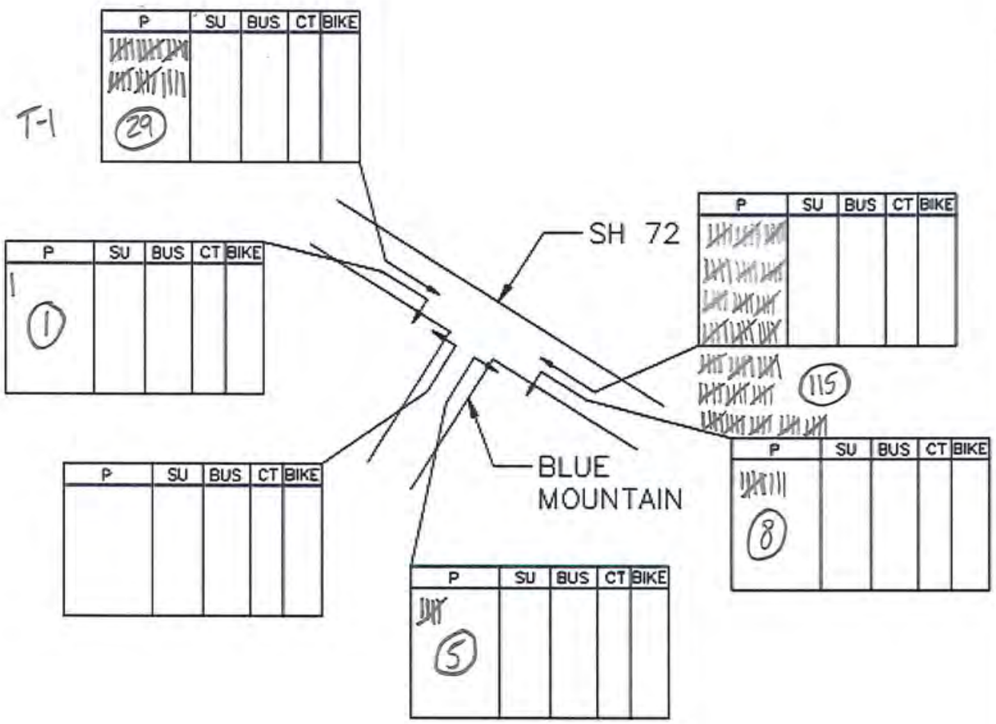
5:15 - 5:30

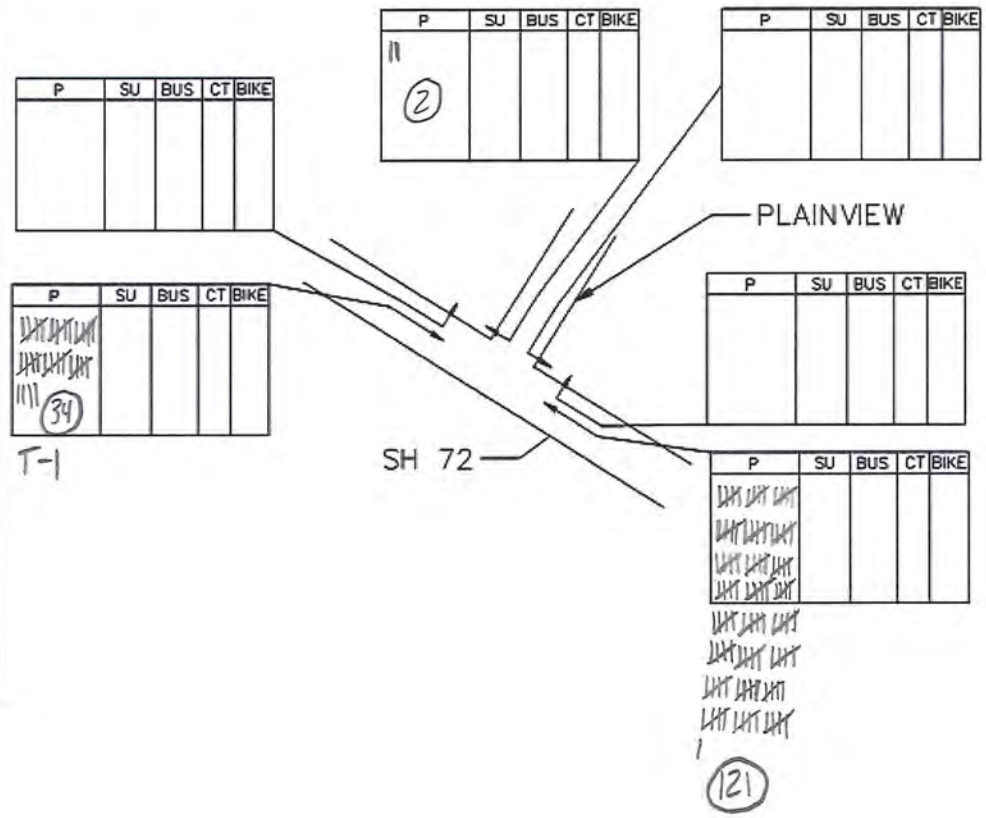

P
SU
BUS
CT
BIKE
25
1
1
72
7
7
SH 72
BLUE
MOUNTAIN
32
1
1
1
4
78
PLAINVIEW
SH 72

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 5:30pm to 5:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

5:30-5:45



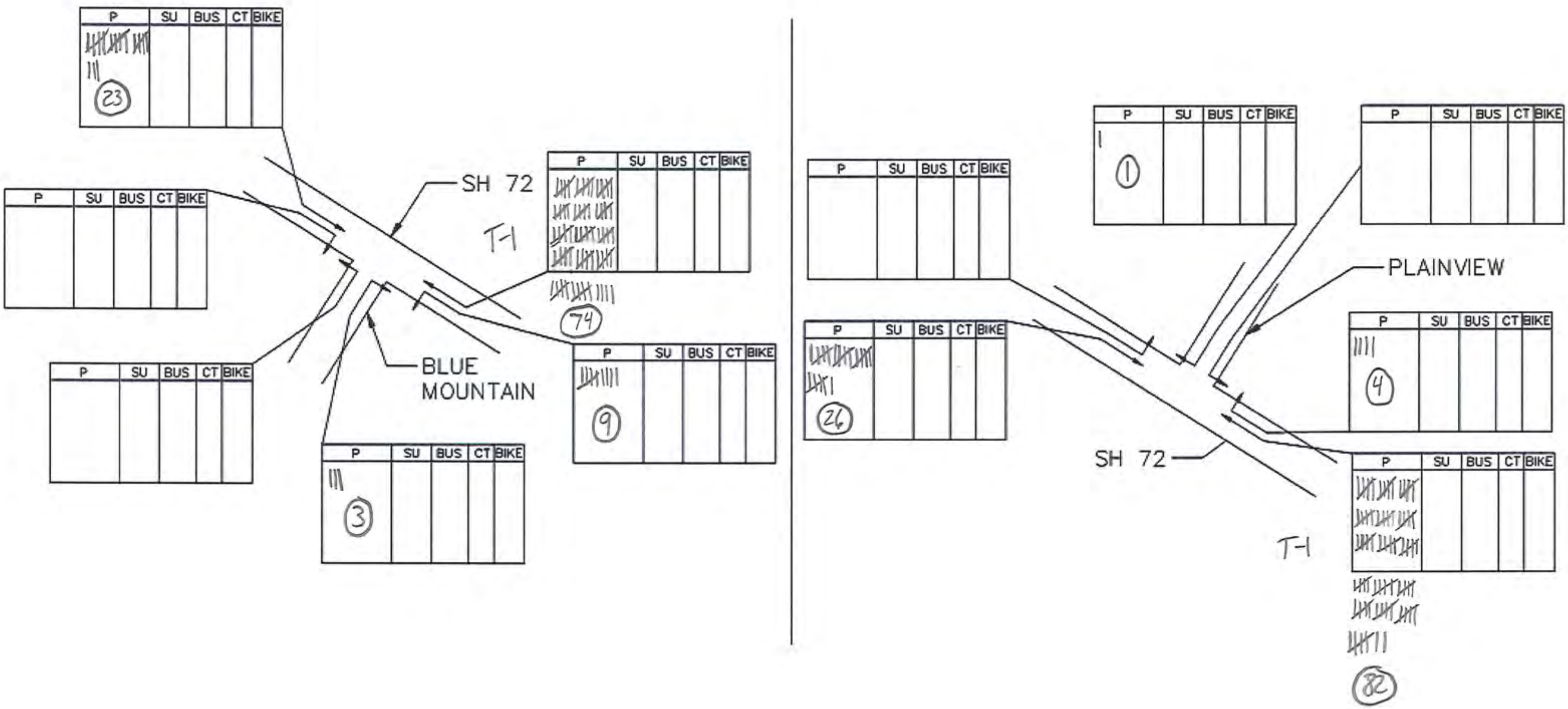


* The trailer ticks indicate the number of vehicles under the vehicle column with trailers and are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Blue Mountain Road and Plainview Road – Prioritize Blue Mountain Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 5:45pm to 6:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

5:45 - 6:00



* The trailer ticks indicate the number of vehicles under the vehicle column w/ trailers and are double marked but counted once

Intersection: SH 72 and Twin Spruce Road

Time Increment	SH 72				Twin Spruce		Total
	Left WB	Through WB	Through EB	Right EB	Left WB	Right EB	
9-9:15	1	19	29	2	1	11	63
9:15-9:30	5	23	39	2	0	10	79
9:30-9:45	3	13	32	2	1	5	56
9:45-10	3	21	41	1	3	2	71
10-10:15	2	12	39	5	3	7	68
10:15-10:30	8	12	36	2	4	4	66
10:30-10:45	4	19	26	2	3	10	64
10:45-11	2	12	25	0	1	5	45

Time Increment	SH 72				Twin Spruce		Total
	Left WB	Through WB	Through EB	Right EB	Left WB	Right EB	
4-4:15	13	43	29	4	4	6	99
4:15-4:30	18	42	24	3	1	4	92
4:30-4:45	16	52	32	3	7	4	114
4:45-5	21	53	28	3	1	7	113
5-5:15	17	49	18	6	3	4	97
5:15-5:30	21	63	27	7	2	3	123
5:30-5:45	22	83	20	4	3	1	133
5:45-6	18	67	18	6	0	3	112

Indicates peak hour

SH 72 and Gross Dam Road Traffic Counts

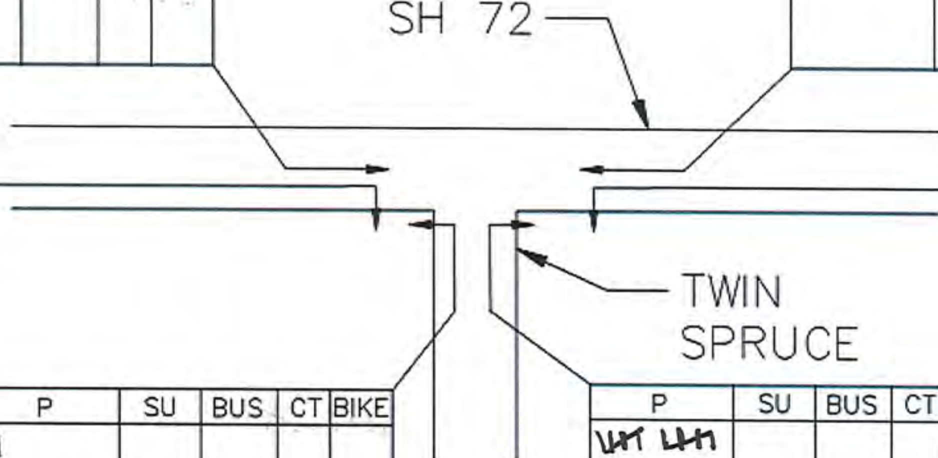
Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:00am to 9:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 ||||				

P	SU	BUS	CT	BIKE
卌 卌 卌 ||||				

P	SU	BUS	CT	BIKE
||				

P	SU	BUS	CT	BIKE
|				

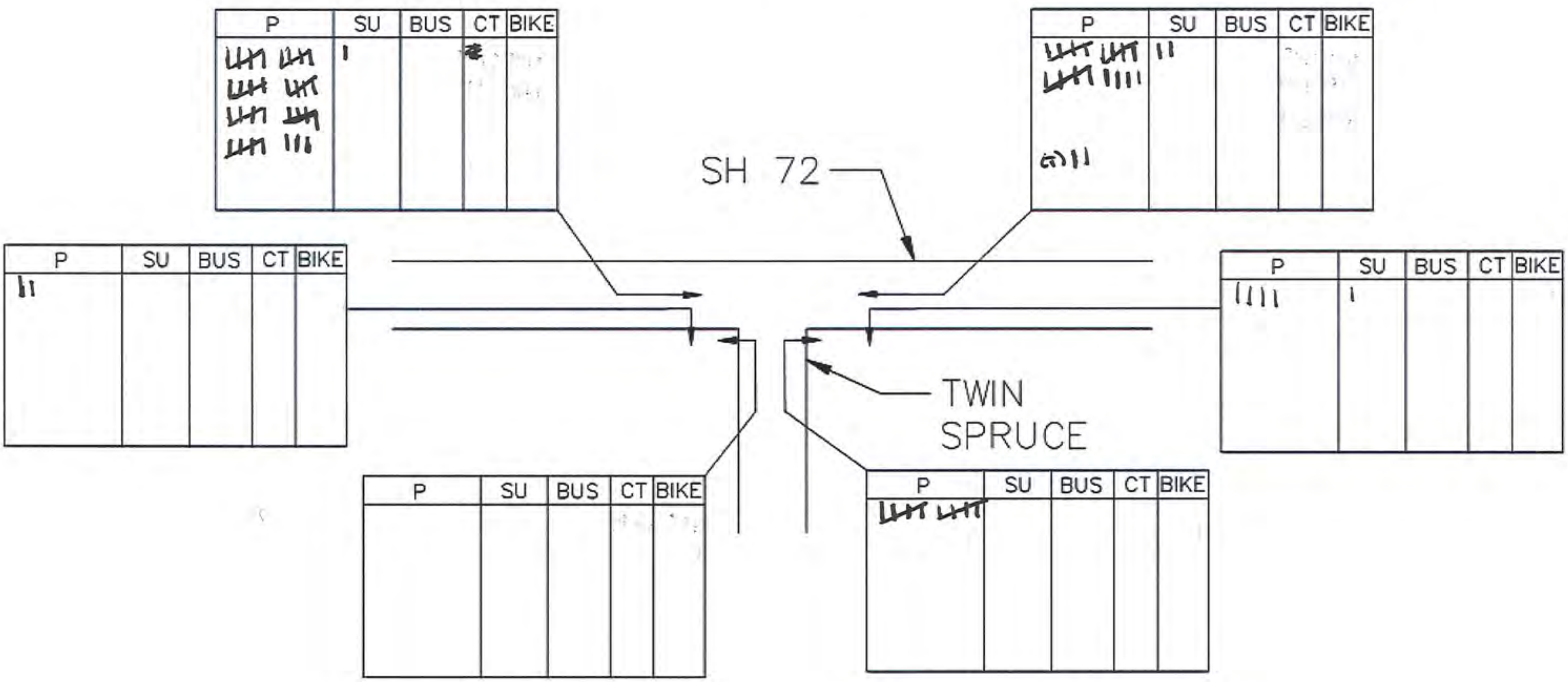


P	SU	BUS	CT	BIKE
|				

P	SU	BUS	CT	BIKE
卌 卌 |				

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:15am to 9:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)



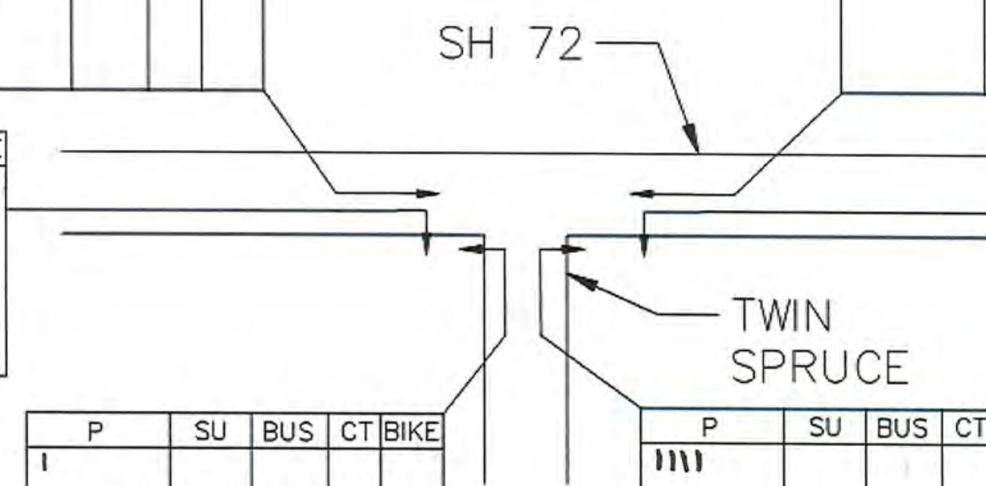
* The trailer ticks indicate # vehicles w/ trailers and are not 'double' marked under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:30am to 9:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
||||/ ||||/ ||||/ ||||/ ||||/ ||||/	||			

P	SU	BUS	CT	BIKE
||||/ ||||/	|||			



P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
|||| (T)					

* The trailer ticks indicate vehicles w/trailers and are not double marked under the vehicle column

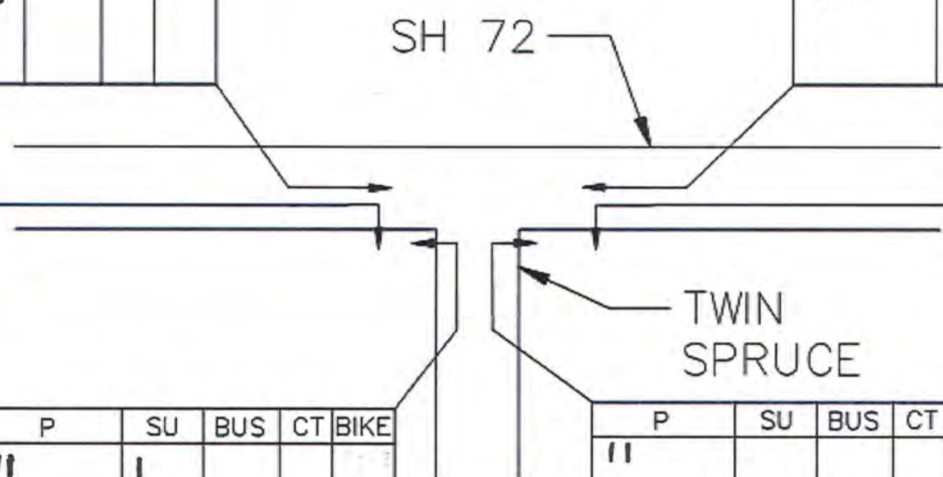
SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 9:45am to 10:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
LHT LHT LHT LHT LHT LHT LHT LHT	(T) I			

SCRAPER W/ PLOW

P	SU	BUS	CT	BIKE
LHT LHT LHT II (T) I	III			



P	SU	BUS	CT	BIKE
I				

P	SU	BUS	CT	BIKE
I (T) I	I			

P	SU	BUS	CT	BIKE
II	I			

P	SU	BUS	CT	BIKE
II				

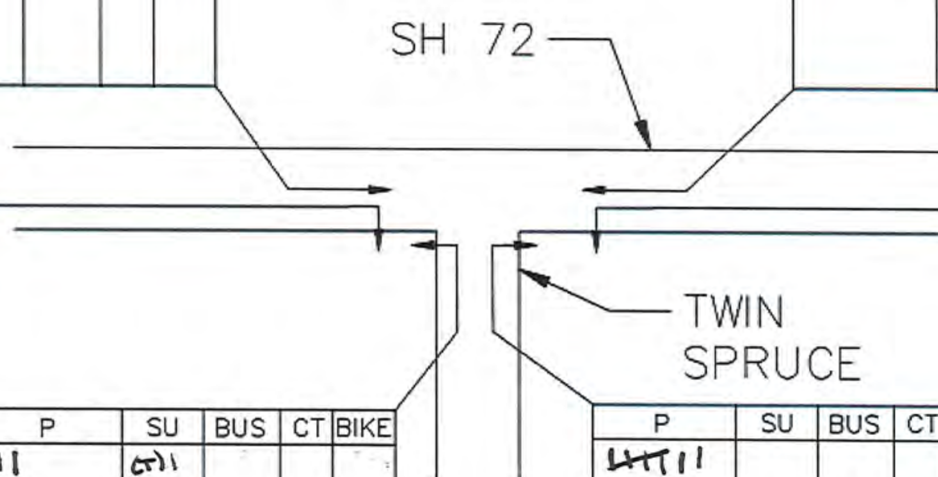
* The trailer ticks indicate vehicles w/trailers and are not "double" marked under the vehicle column.

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:00am to 10:15am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 卌 卌 |||	|			

P	SU	BUS	CT	BIKE
卌 卌 ||				



P	SU	BUS	CT	BIKE
卌				

P	SU	BUS	CT	BIKE
||				

P	SU	BUS	CT	BIKE
||	(T)|			

P	SU	BUS	CT	BIKE
卌 ||				

* The trailer ticks indicate vehicles w/trailers and are not double marked under the vehicle column

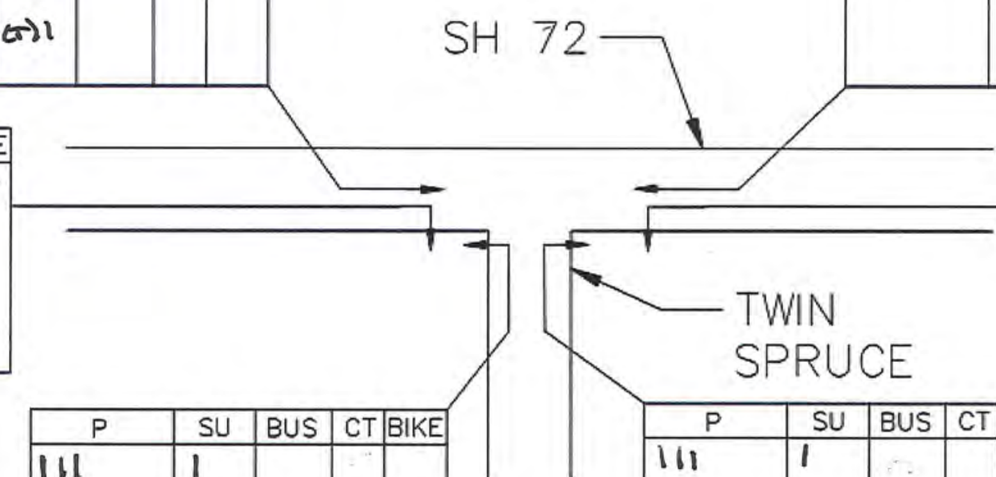
SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:15am to 10:30am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 卌 ||||	| (T)|			

P	SU	BUS	CT	BIKE
卌 卌 |	|			

P	SU	BUS	CT	BIKE
|	|			



P	SU	BUS	CT	BIKE
卌 |||				

P	SU	BUS	CT	BIKE
|||	|			

P	SU	BUS	CT	BIKE
|||	|			

* the trailer ticks indicate vehicles with trailers and are not double marked under the vehicle column

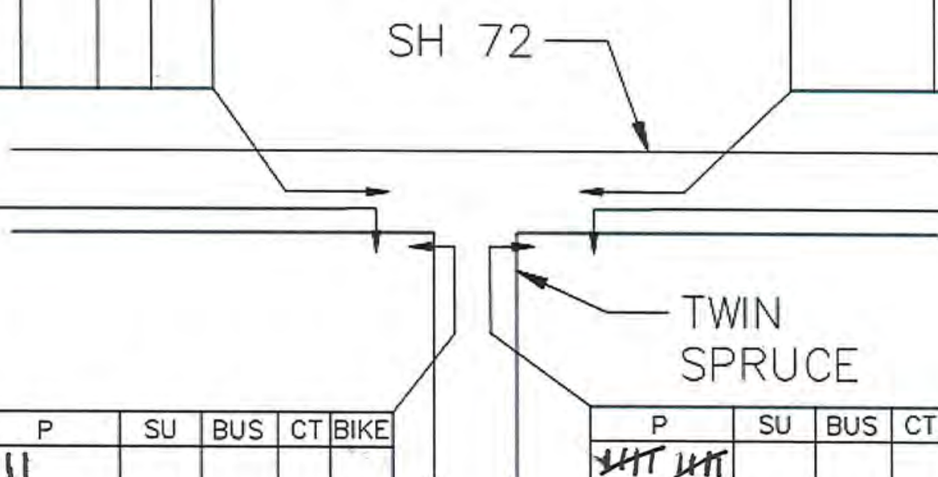
SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/8/15
Time Period: 9-11am
Time Increment: 10:30am to 10:45am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
𝍸 𝍸 𝍸 𝍸 𝍸 I				

P	SU	BUS	CT	BIKE
𝍸 𝍸 𝍸 III	I			

P	SU	BUS	CT	BIKE
I	I			



P	SU	BUS	CT	BIKE
IIII				

P	SU	BUS	CT	BIKE
III				

P	SU	BUS	CT	BIKE
𝍸 𝍸				

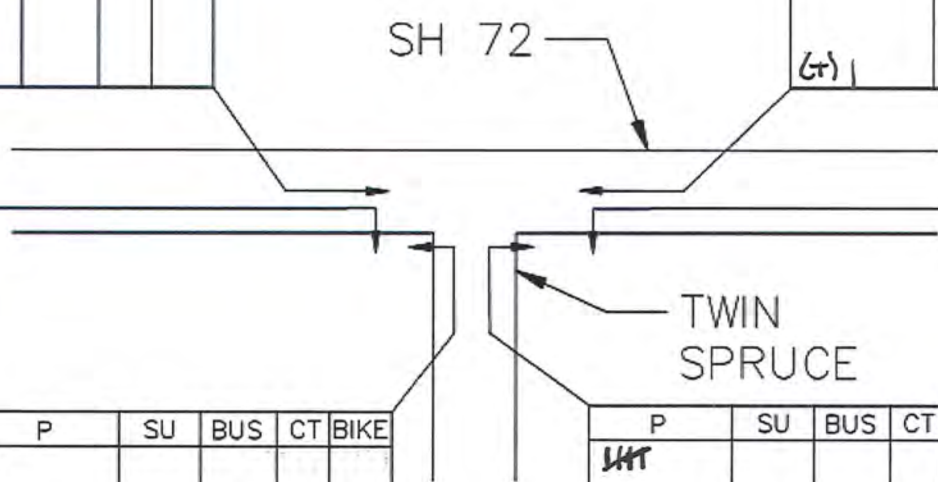
SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 9-11am
Time Increment: 10:45am to 11:00am
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 |||| (T) |				

P	SU	BUS	CT	BIKE
卌 卌 (T) |	|			

P	SU	BUS	CT	BIKE



P	SU	BUS	CT	BIKE
| (T) |				

P	SU	BUS	CT	BIKE
|				

P	SU	BUS	CT	BIKE
卌				

* The trailer ticks indicate vehicles with trailers and are not double marked under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

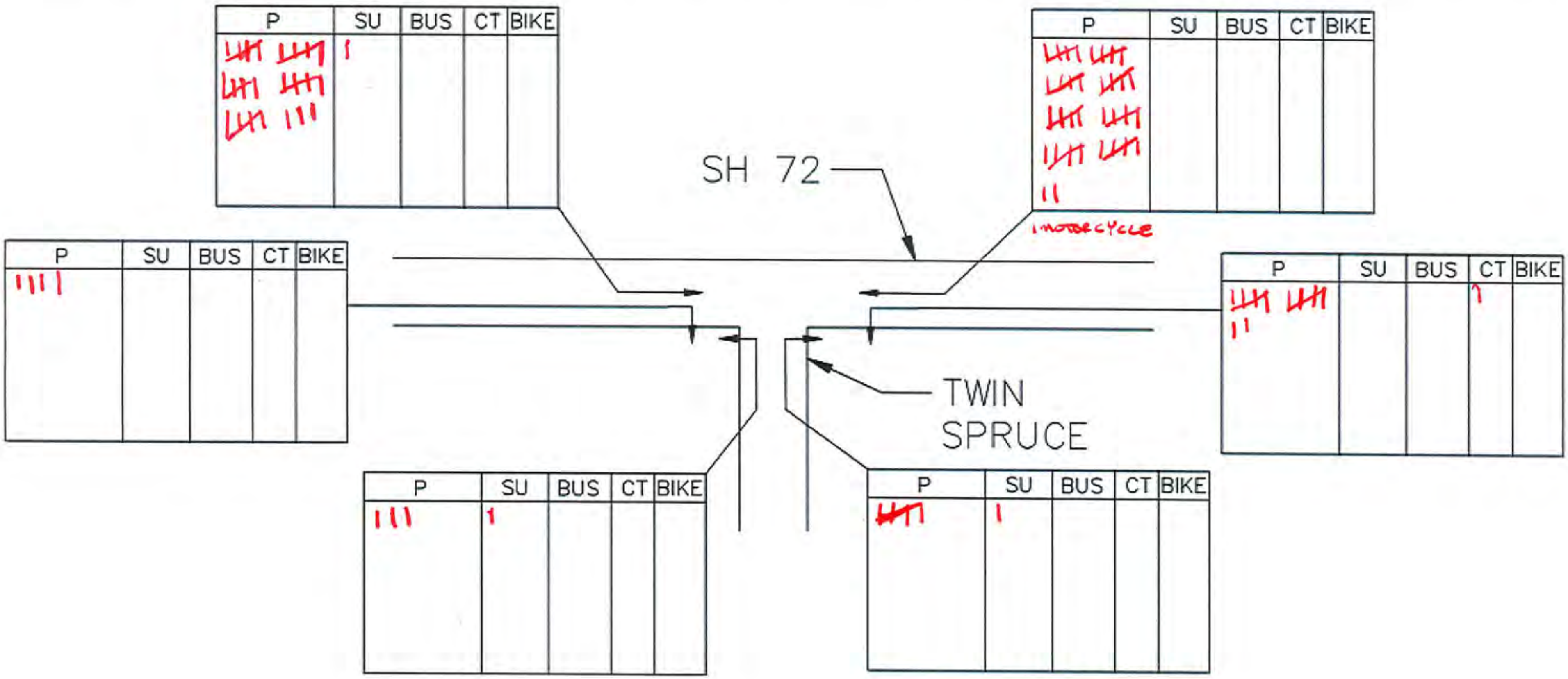
Location: SH 72 and Twin Spruce Road

Date: 12/9/15

Time Period: 4-6pm

Time Increment: 4:00pm to 4:15pm

Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)



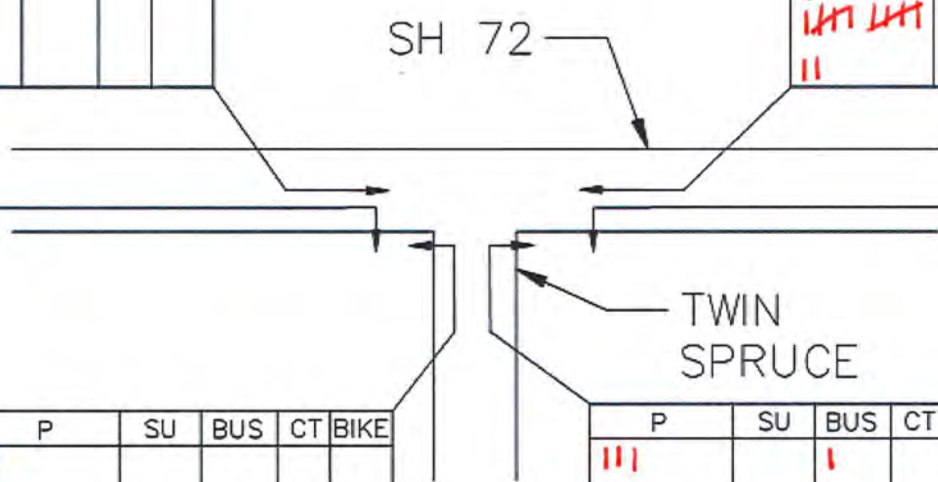
* The motorcycles are indicated but tallied under "P"; – they are double marked but counted once

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:15pm to 4:30pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 |||					

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 卌 卌 卌 ||				



P	SU	BUS	CT	BIKE

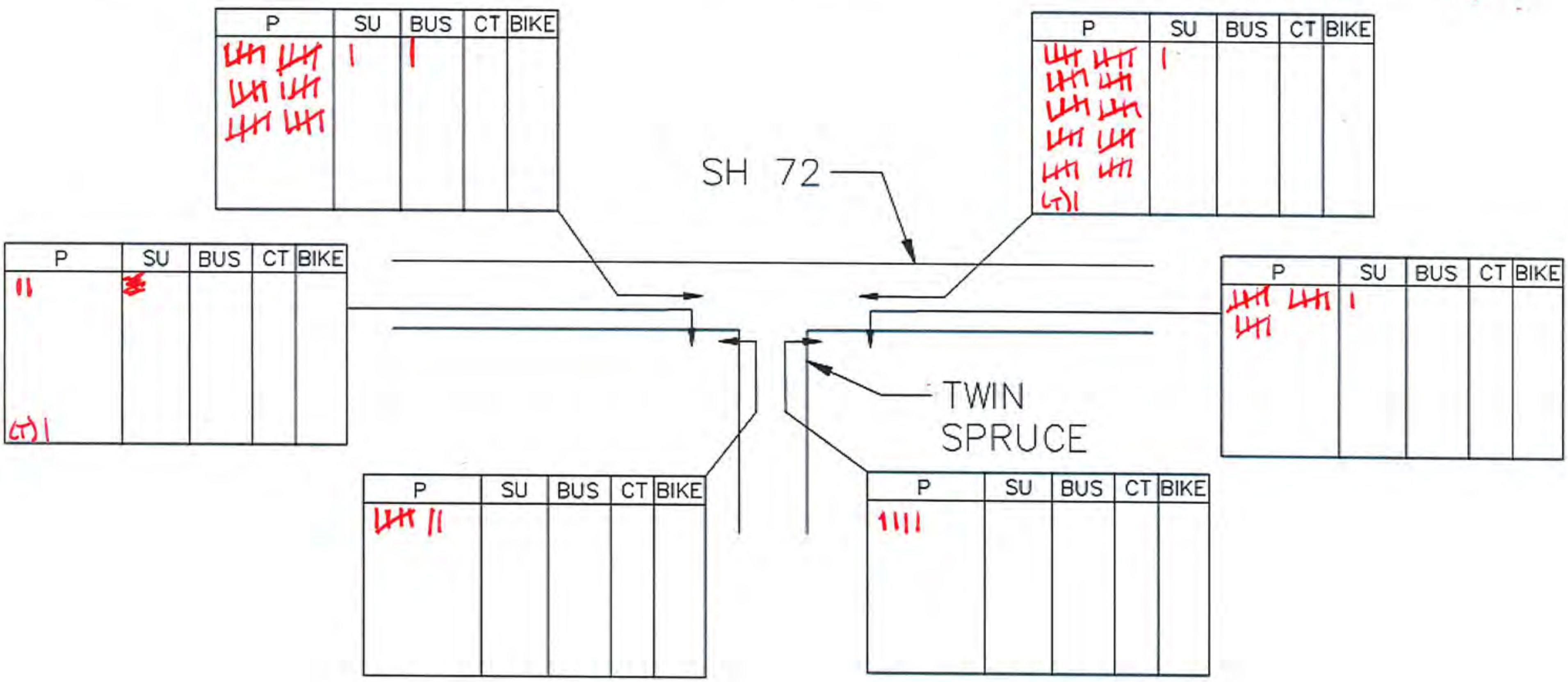
P	SU	BUS	CT	BIKE
卌 卌 卌 |||				

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

SH 72 and Gross Dam Road Traffic Counts

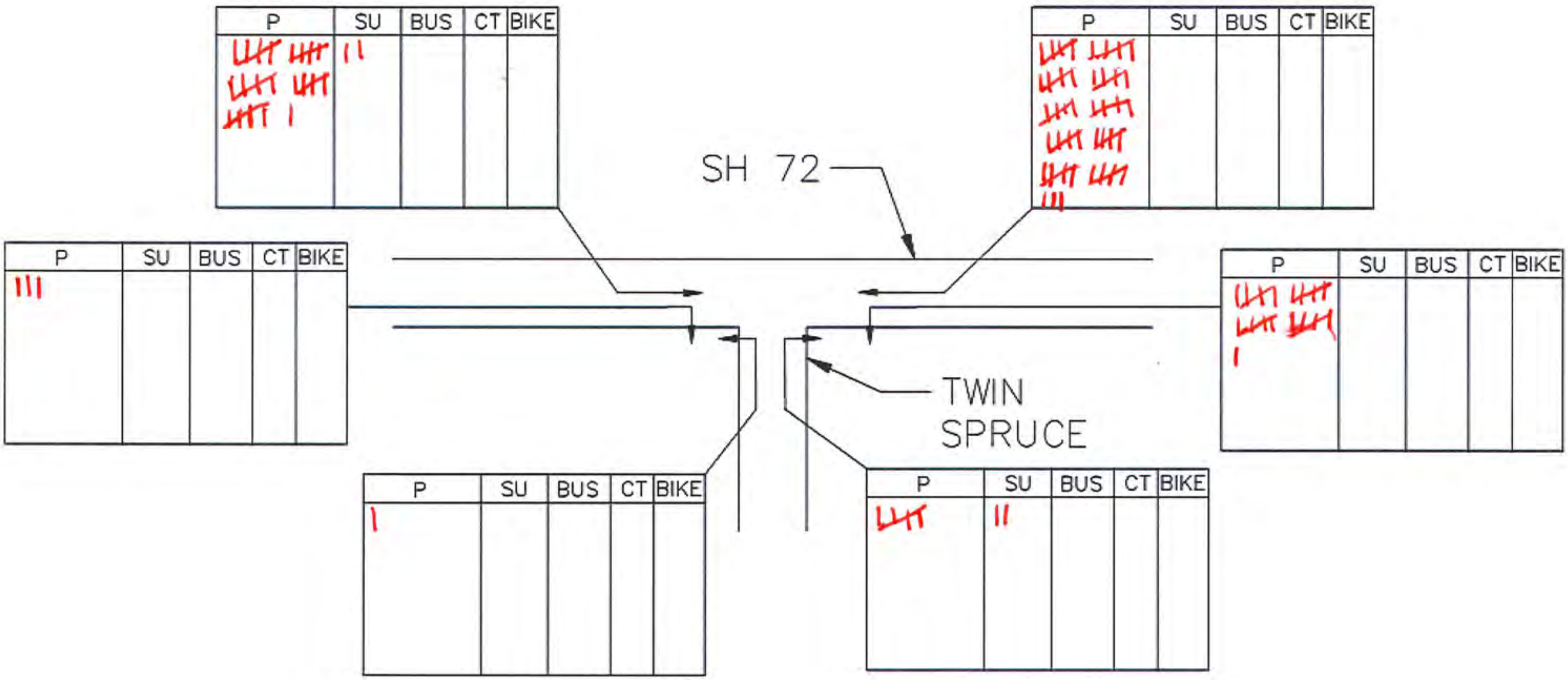
Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:30pm to 4:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)



* Trailer ticks indicate vehicles with trailers and are not double marked under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 4:45pm to 5:00pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)



P	SU	BUS	CT	BIKE
26	2			

P	SU	BUS	CT	BIKE
53				

P	SU	BUS	CT	BIKE
3				

P	SU	BUS	CT	BIKE
21				

P	SU	BUS	CT	BIKE
1				

P	SU	BUS	CT	BIKE
5	2			

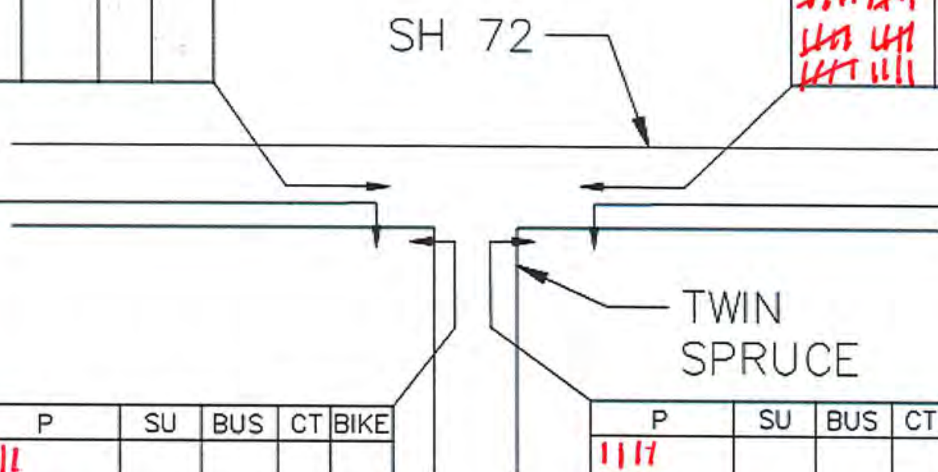
SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 5:00pm to 5:15pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 ||	|			

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 卌 卌 卌 卌 ||||				

P	SU	BUS	CT	BIKE
||||	||			



P	SU	BUS	CT	BIKE
卌 卌 卌 ||				

P	SU	BUS	CT	BIKE
|||				

P	SU	BUS	CT	BIKE
||||				

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road

Date: 12/9/15

Time Period: 4-6pm

Time Increment: 5:15pm to 5:30pm

Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 |卌||				

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 (T)| 卌 卌 ||				

SH 72

P	SU	BUS	CT	BIKE
卌|					

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 (T)|				

TWIN SPRUCE

P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE

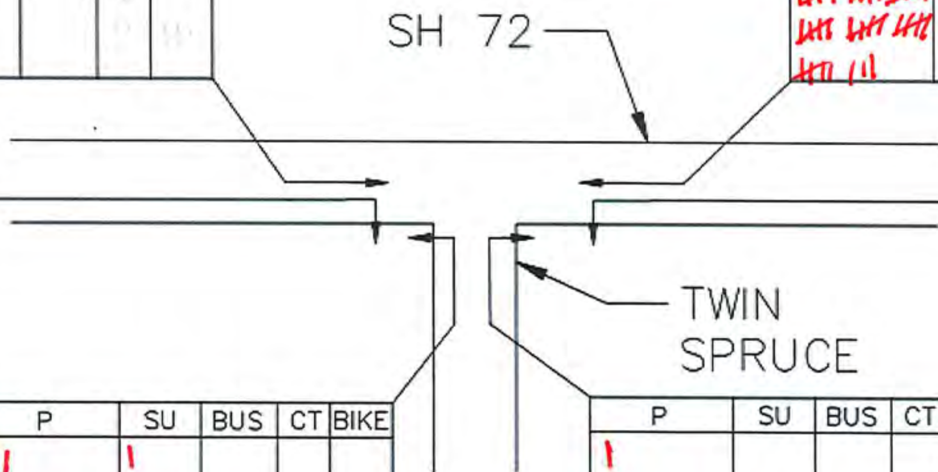
* The trailer ticks indicate vehicles with trailers and are not double counted under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road
Date: 12/9/15
Time Period: 4-6pm
Time Increment: 5:30pm to 5:45pm
Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
卌 卌 卌 |||| (T) |				

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 |||				



P	SU	BUS	CT	BIKE
|||	|			

P	SU	BUS	CT	BIKE
卌 卌 卌 卌 ||				

P	SU	BUS	CT	BIKE
||	|			

P	SU	BUS	CT	BIKE
|				

* The trailer ticks indicate vehicles with trailers and are not double marked under the vehicle column

SH 72 and Gross Dam Road Traffic Counts

Location: SH 72 and Twin Spruce Road

Date: 12/9/15

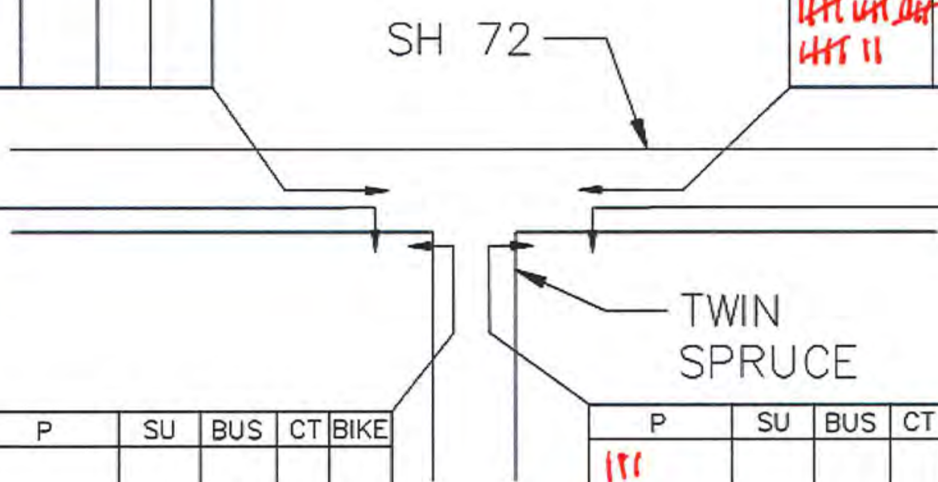
Time Period: 4-6pm

Time Increment: 5:45pm to 6:00pm

Legend: P: Passenger, SU: Single Unit Truck, BUS: City or School Bus, CT: Combination Truck (articulating cab), BIKE: Bike, T: Trailer (add next to tick mark)

P	SU	BUS	CT	BIKE
𝍸 𝍸 𝍸 𝍷𝍷𝍷				

P	SU	BUS	CT	BIKE
𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍷𝍷				



P	SU	BUS	CT	BIKE
𝍸 𝍷				

P	SU	BUS	CT	BIKE
𝍸 𝍸 𝍸 𝍷𝍷𝍷				

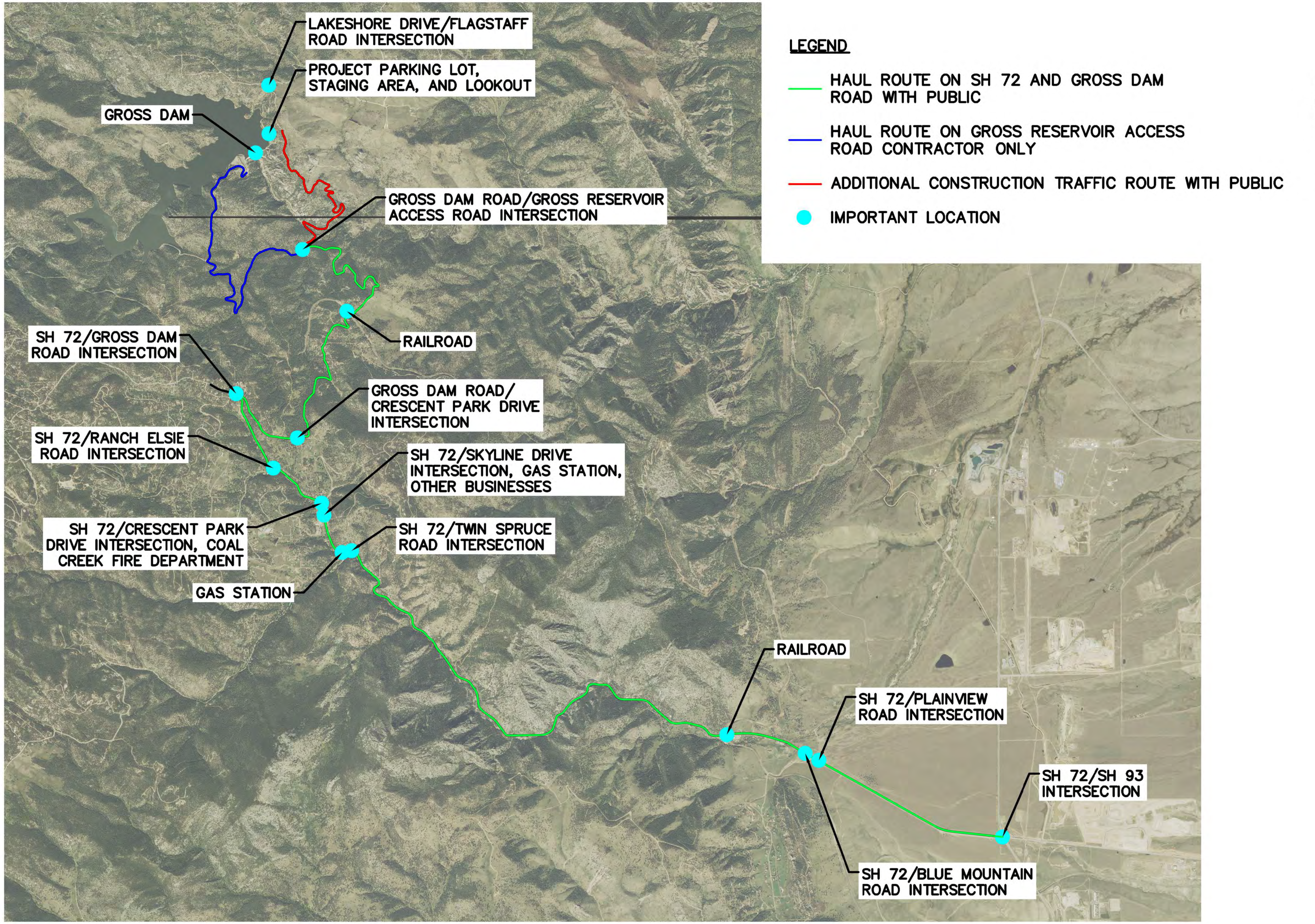
P	SU	BUS	CT	BIKE

P	SU	BUS	CT	BIKE
𝍷𝍷𝍷				

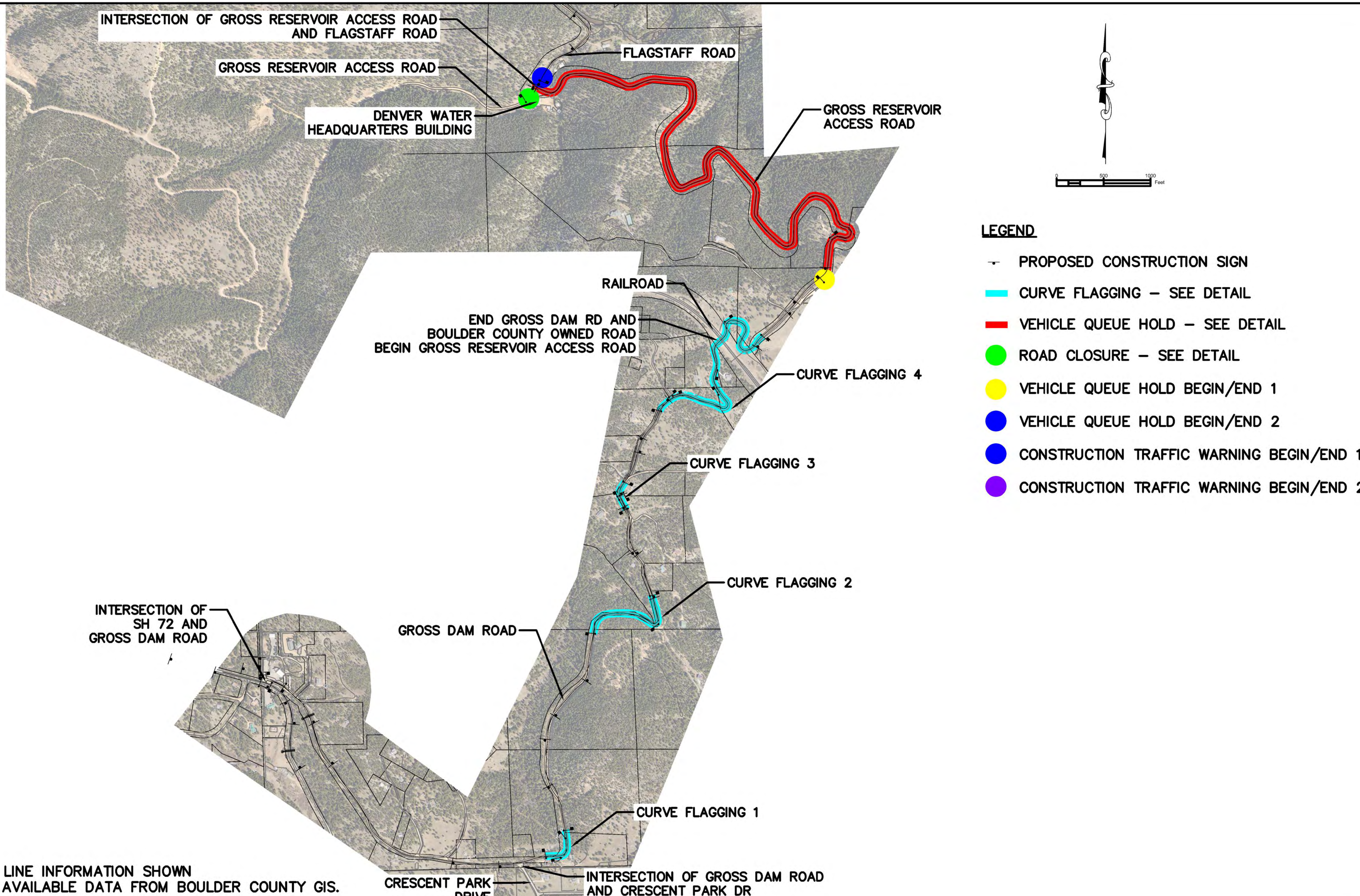
Exhibits

GROSS RESERVOIR EXPANSION PROJECT

PROJECT LOCATION



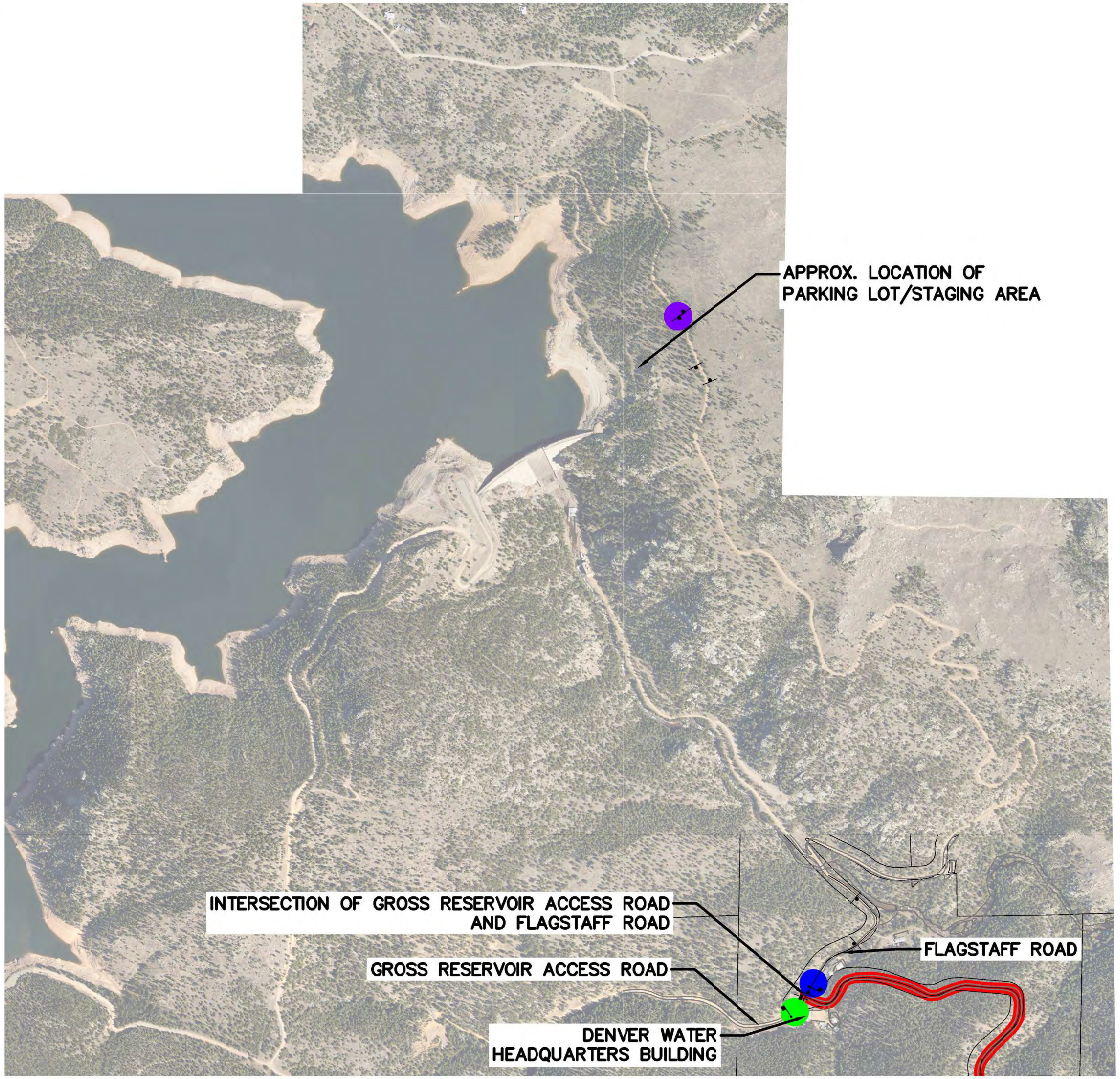
GROSS RESERVOIR EXPANSION PROJECT	HAUL ROUTE AND LIMITS OF CONSTRUCTION TRAFFIC



NOTES

1. PROPERTY LINE INFORMATION SHOWN IS THE BEST AVAILABLE DATA FROM BOULDER COUNTY GIS.

GROSS RESERVOIR EXPANSION PROJECT	GROSS DAM SIGNAGE OVERVIEW PART 1



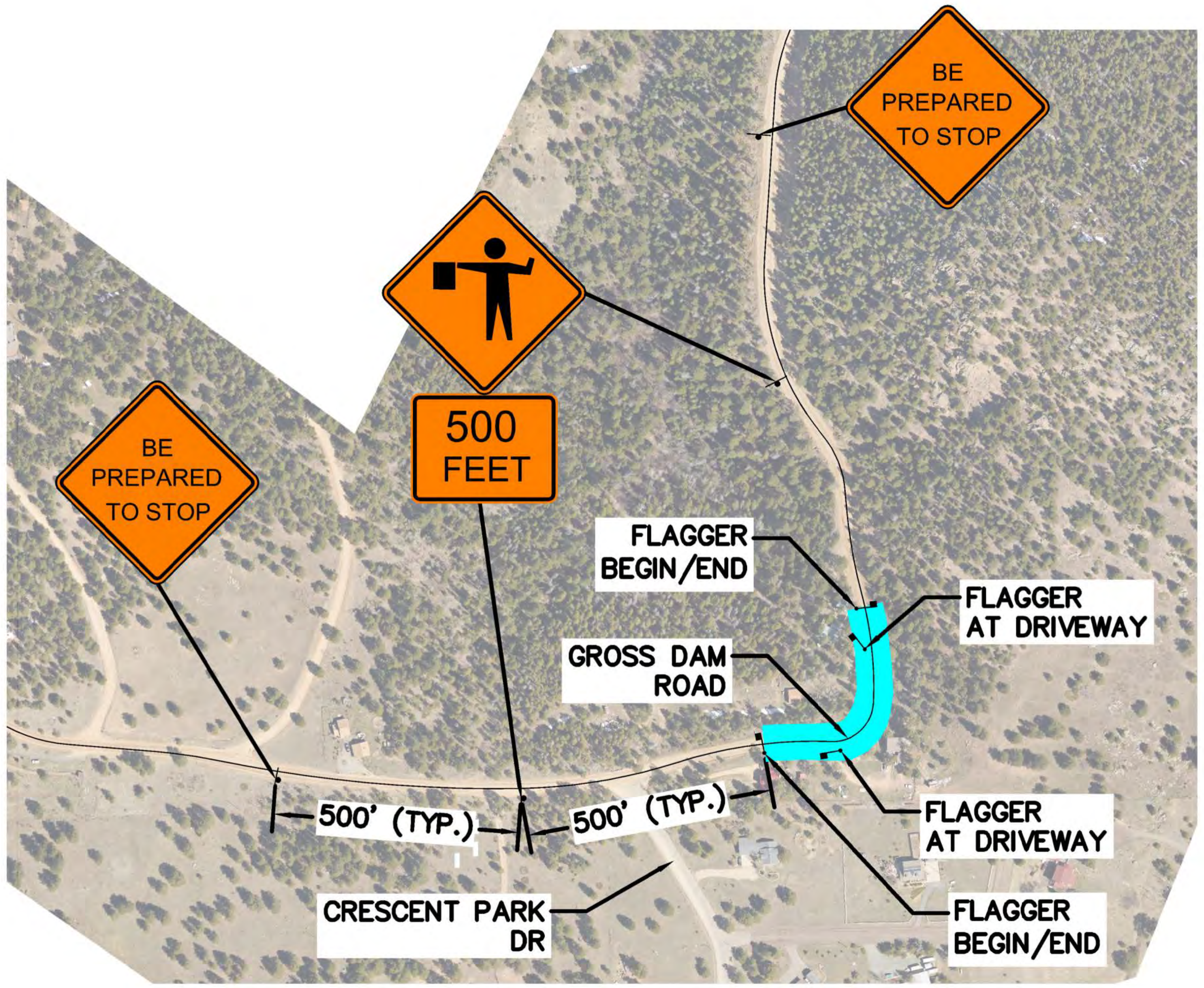
LEGEND

- PROPOSED CONSTRUCTION SIGN
- CURVE FLAGGING – SEE DETAIL
- VEHICLE QUEUE HOLD – SEE DETAIL
- ROAD CLOSURE – SEE DETAIL
- VEHICLE QUEUE HOLD BEGIN/END 1
- VEHICLE QUEUE HOLD BEGIN/END 2
- CONSTRUCTION TRAFFIC WARNING BEGIN/END 1
- CONSTRUCTION TRAFFIC WARNING BEGIN/END 2

NOTES

1. PROPERTY LINE INFORMATION SHOWN IS THE BEST AVAILABLE DATA FROM BOULDER COUNTY GIS.

GROSS RESERVOIR EXPANSION PROJECT	GROSS DAM SIGNAGE OVERVIEW PART 2

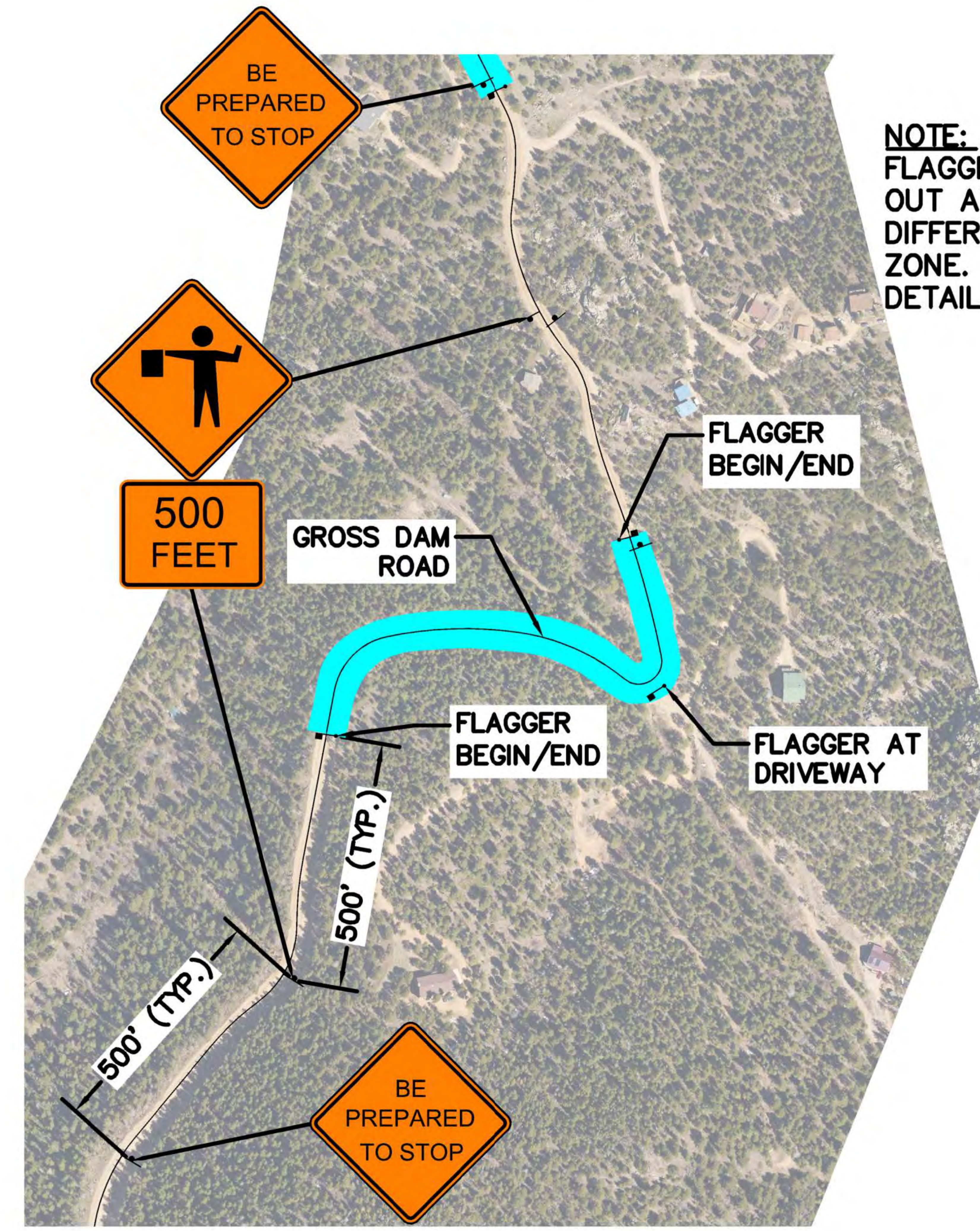


CURVE FLAGGING 1: FLAGGERS AT BLIND CURVES (ONE-WAY TRAFFIC ONLY AND FLAGGER CONTROL AT DRIVEWAYS WHEN TRUCK TRAFFIC IS PRESENT)

LEGEND

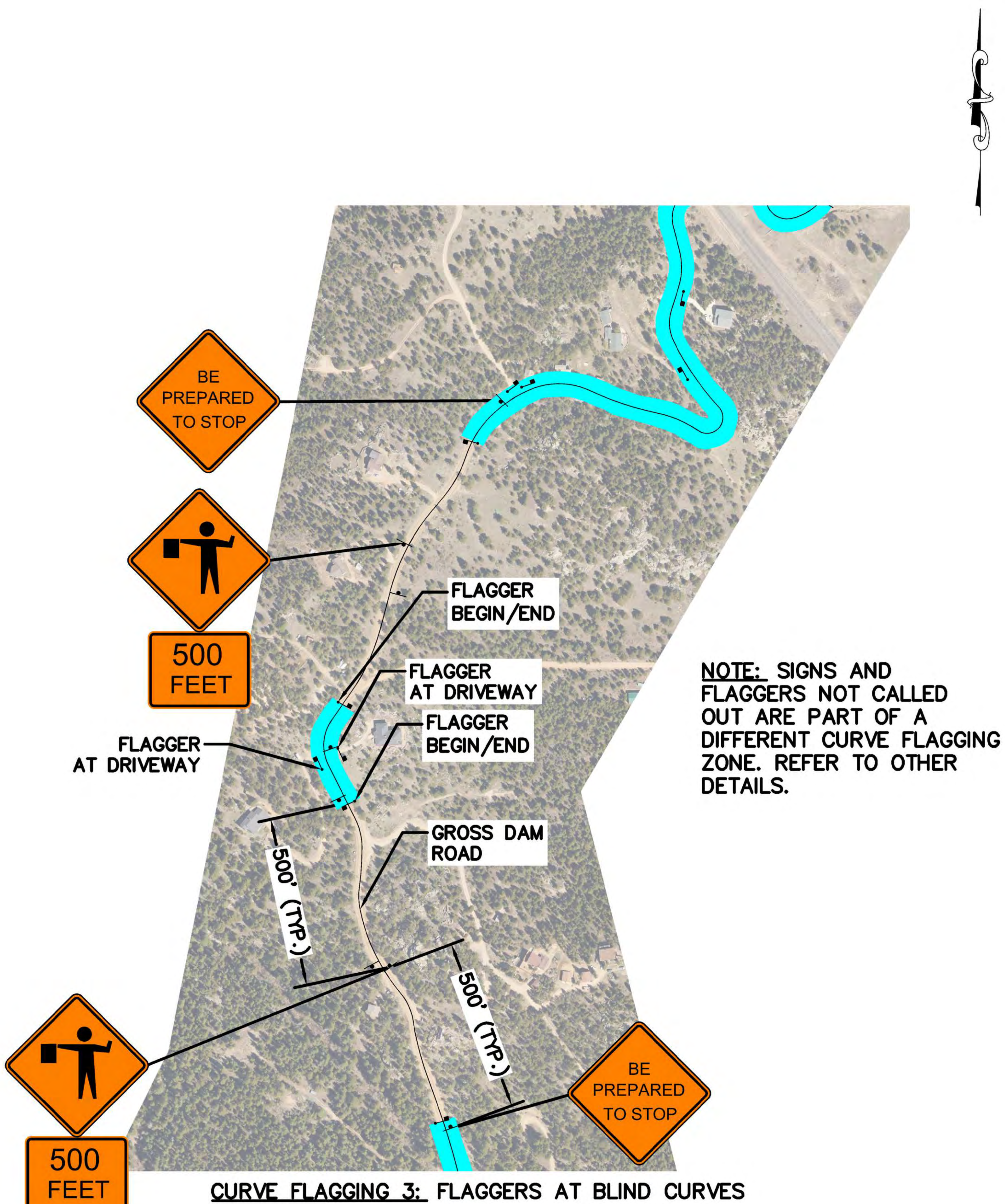
- FLAGGER LOCATION
- PROPOSED CONSTRUCTION SIGN
- CURVE FLAGGING LIMITS

NOTE: SIGNS AND FLAGGERS NOT CALLED OUT ARE PART OF A DIFFERENT CURVE FLAGGING ZONE. REFER TO OTHER DETAILS.

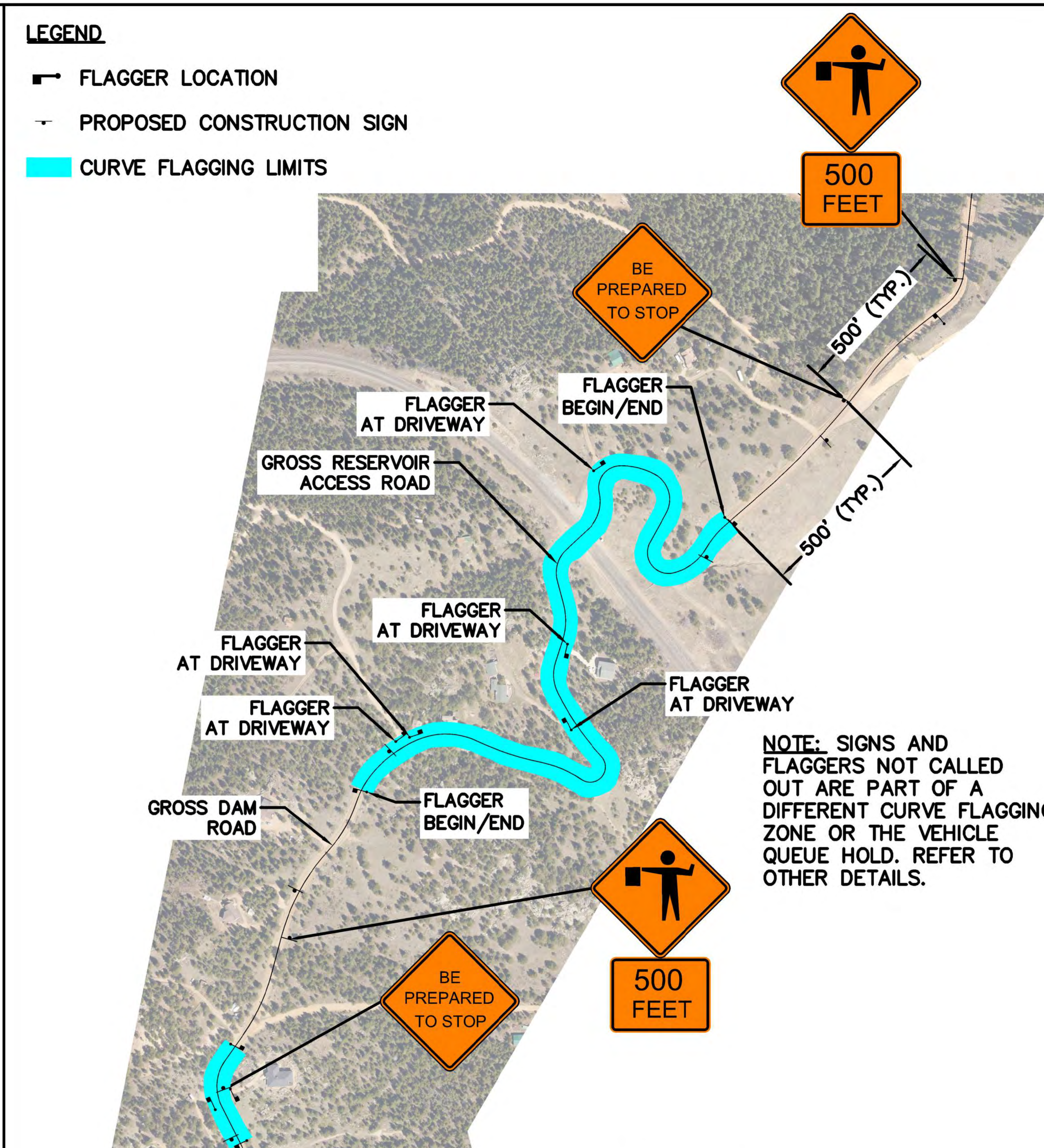


CURVE FLAGGING 2: FLAGGERS AT BLIND CURVES (ONE-WAY TRAFFIC ONLY AND FLAGGER CONTROL AT DRIVEWAYS WHEN TRUCK TRAFFIC IS PRESENT)

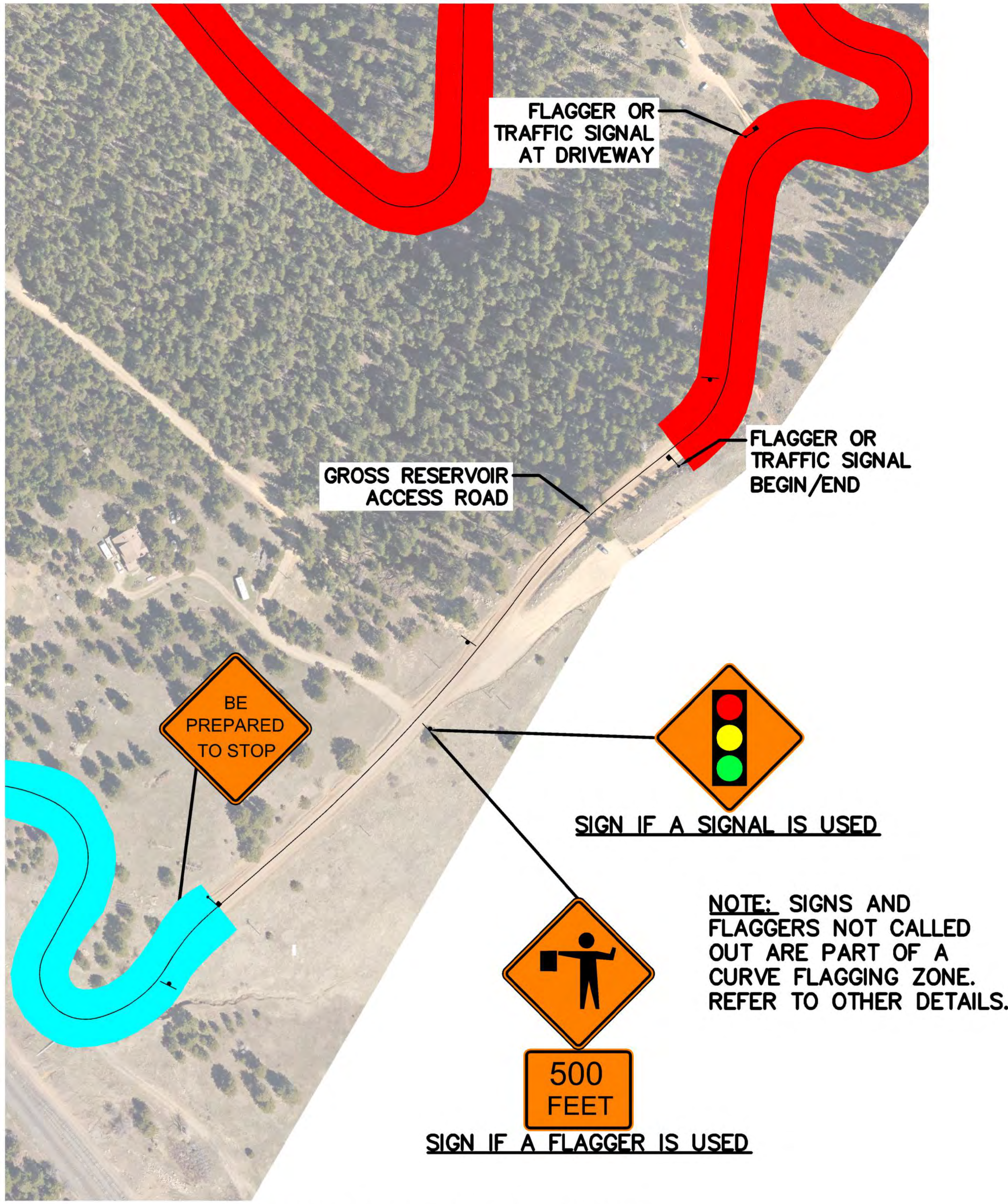
GROSS RESERVOIR EXPANSION PROJECT	GROSS DAM SIGNAGE DETAILS PART 1



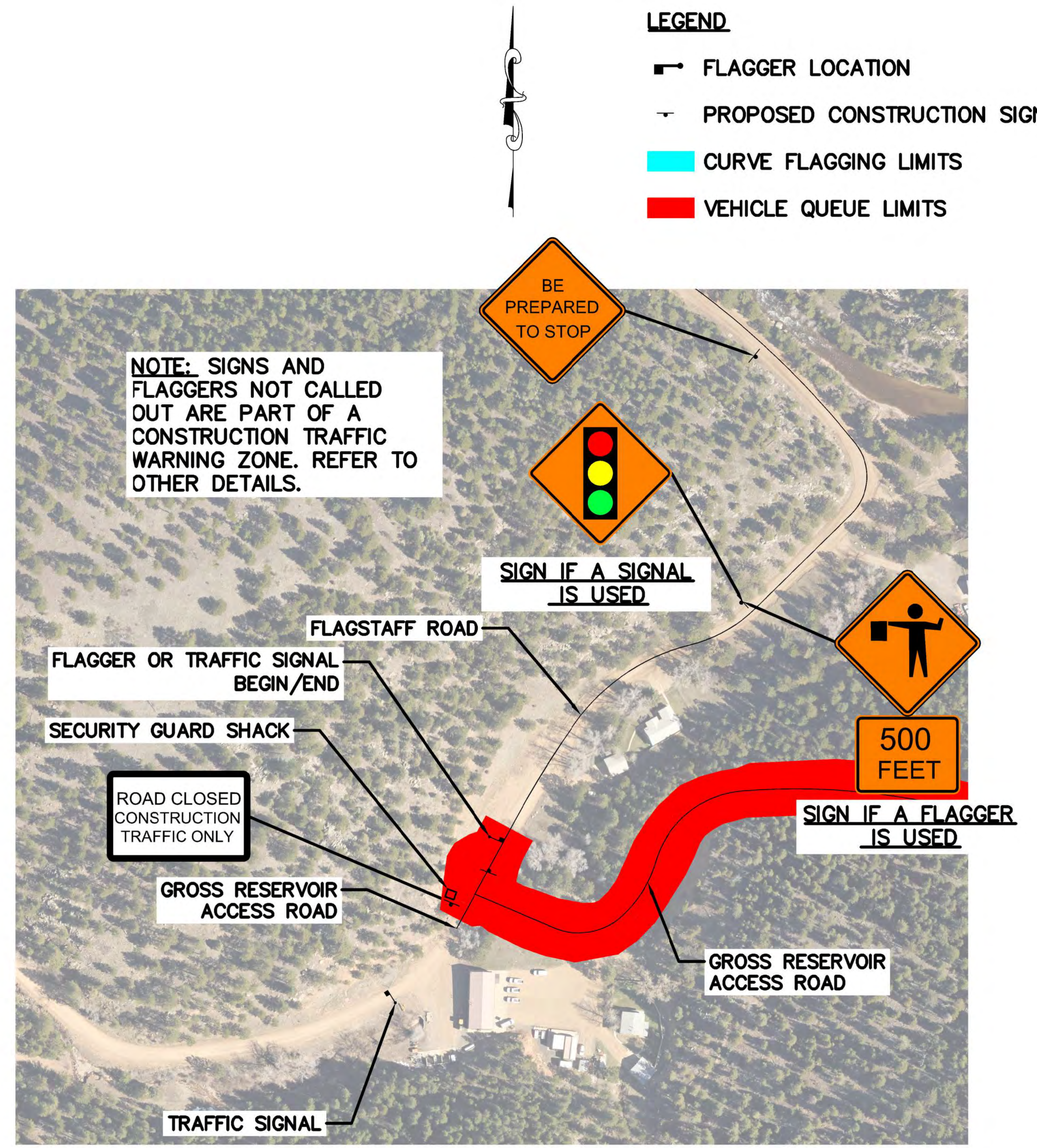
CURVE FLAGGING 3: FLAGGERS AT BLIND CURVES (ONE-WAY TRAFFIC ONLY AND FLAGGER CONTROL AT DRIVEWAYS WHEN TRUCK TRAFFIC IS PRESENT)



CURVE FLAGGING 4: FLAGGERS AT BLIND CURVES (ONE-WAY TRAFFIC ONLY AND FLAGGER CONTROL AT DRIVEWAYS WHEN TRUCK TRAFFIC IS PRESENT)



BEGIN/END 1 VEHICLE QUEUE HOLD



BEGIN/END 2 VEHICLE QUEUE HOLD AND ROAD CLOSURE

VEHICLE QUEUE HOLD: VEHICLE QUEUE HOLD AT SUCCESSIVE BLIND CURVES (ONE-WAY TRAFFIC ONLY AND FLAGGER OR TRAFFIC SIGNAL CONTROL AT DRIVEWAYS WHEN TRUCK TRAFFIC IS PRESENT)

NOTES

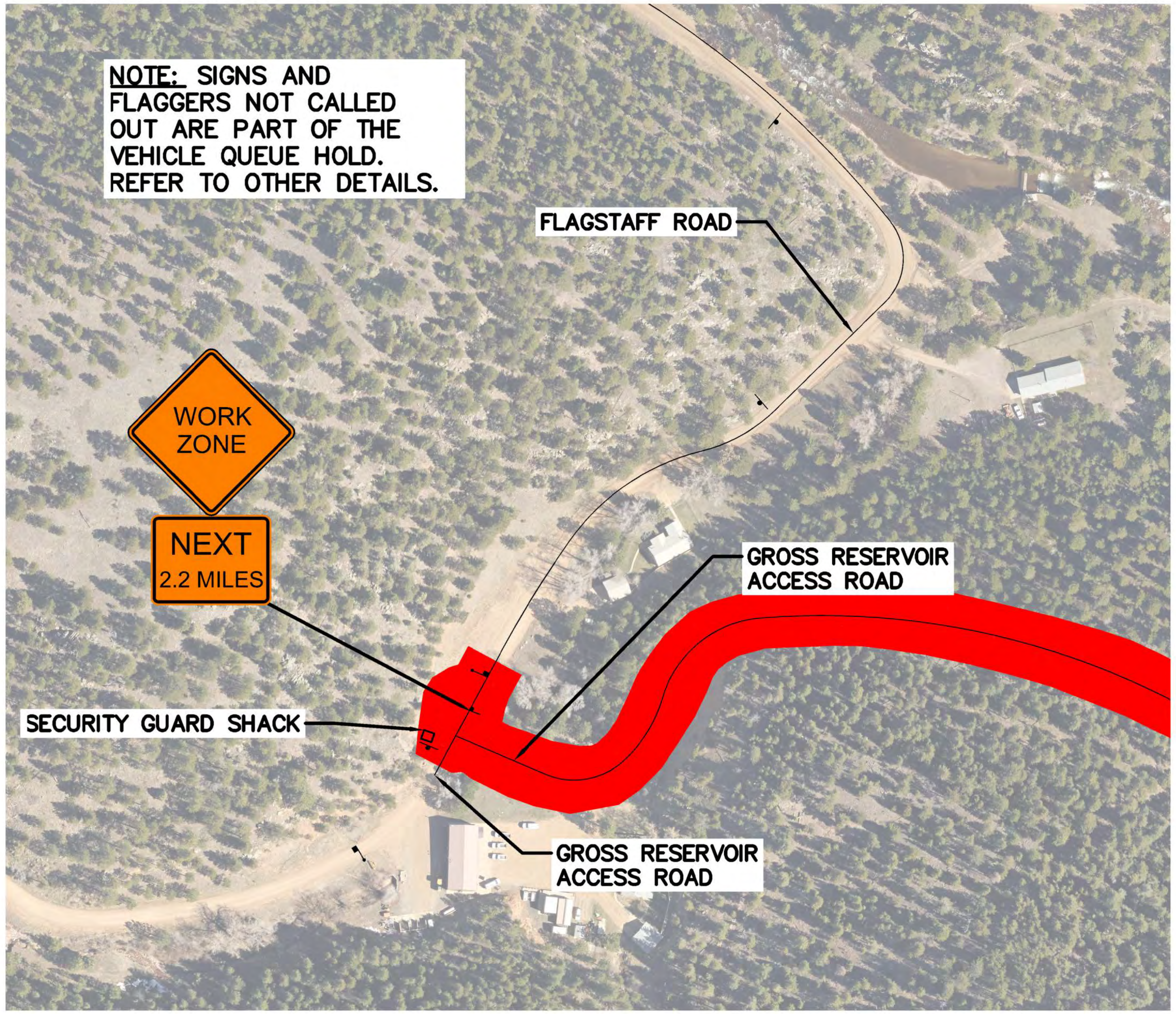
1. THE DISTANCE BETWEEN WARNING SIGNS AND BETWEEN WARNING SIGNS AND FLAGGER OR TRAFFIC SIGNAL LOCATIONS IS 500'.

LEGEND

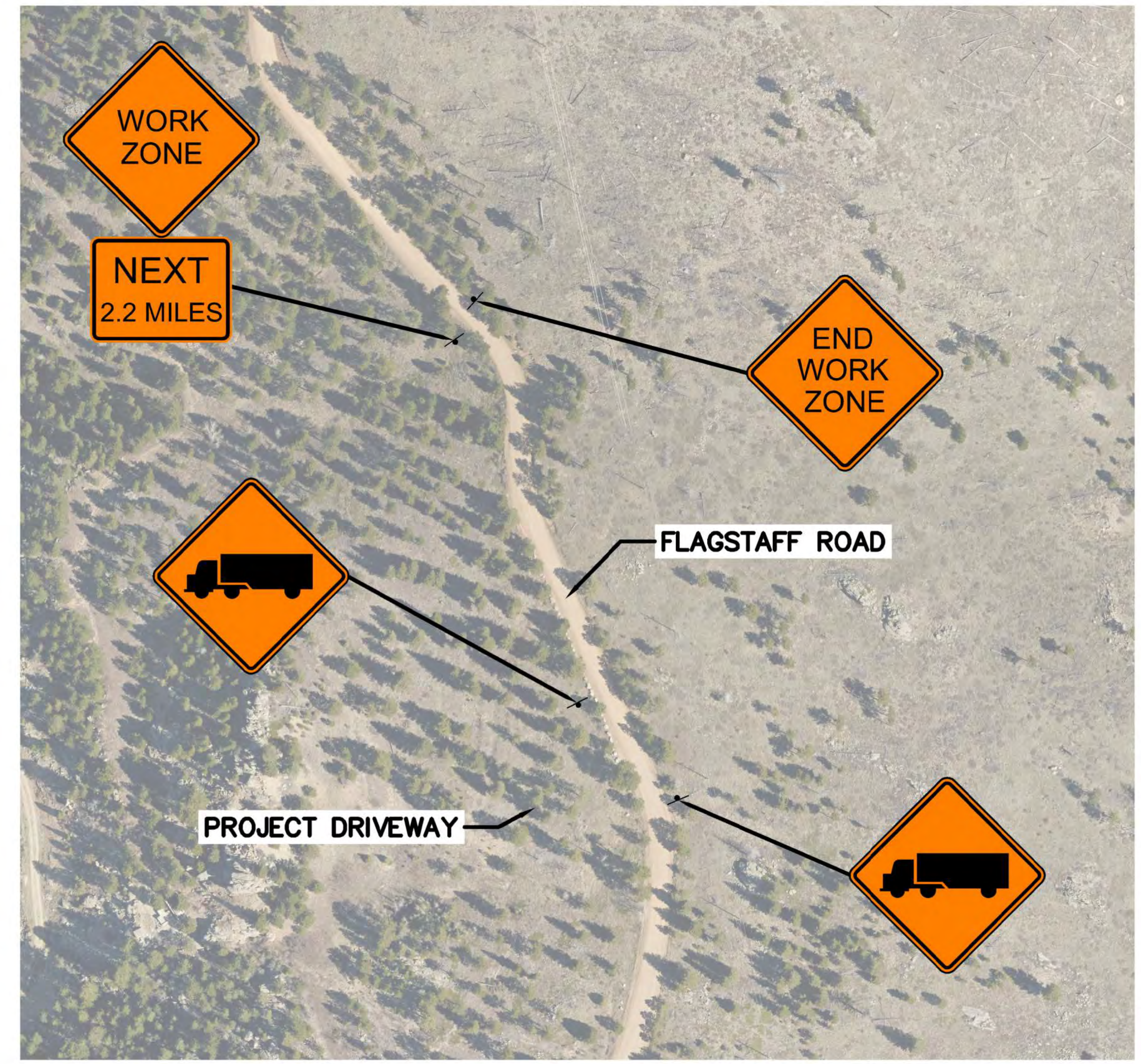
FLAGGER LOCATION

PROPOSED CONSTRUCTION SIGN

VEHICLE QUEUE LIMITS



BEGIN/END 1 CONSTRUCTION TRAFFIC WARNING



BEGIN/END 2 CONSTRUCTION TRAFFIC WARNING

CONSTRUCTION TRAFFIC WARNING: SIGNS WARNING OF CONSTRUCTION TRAFFIC

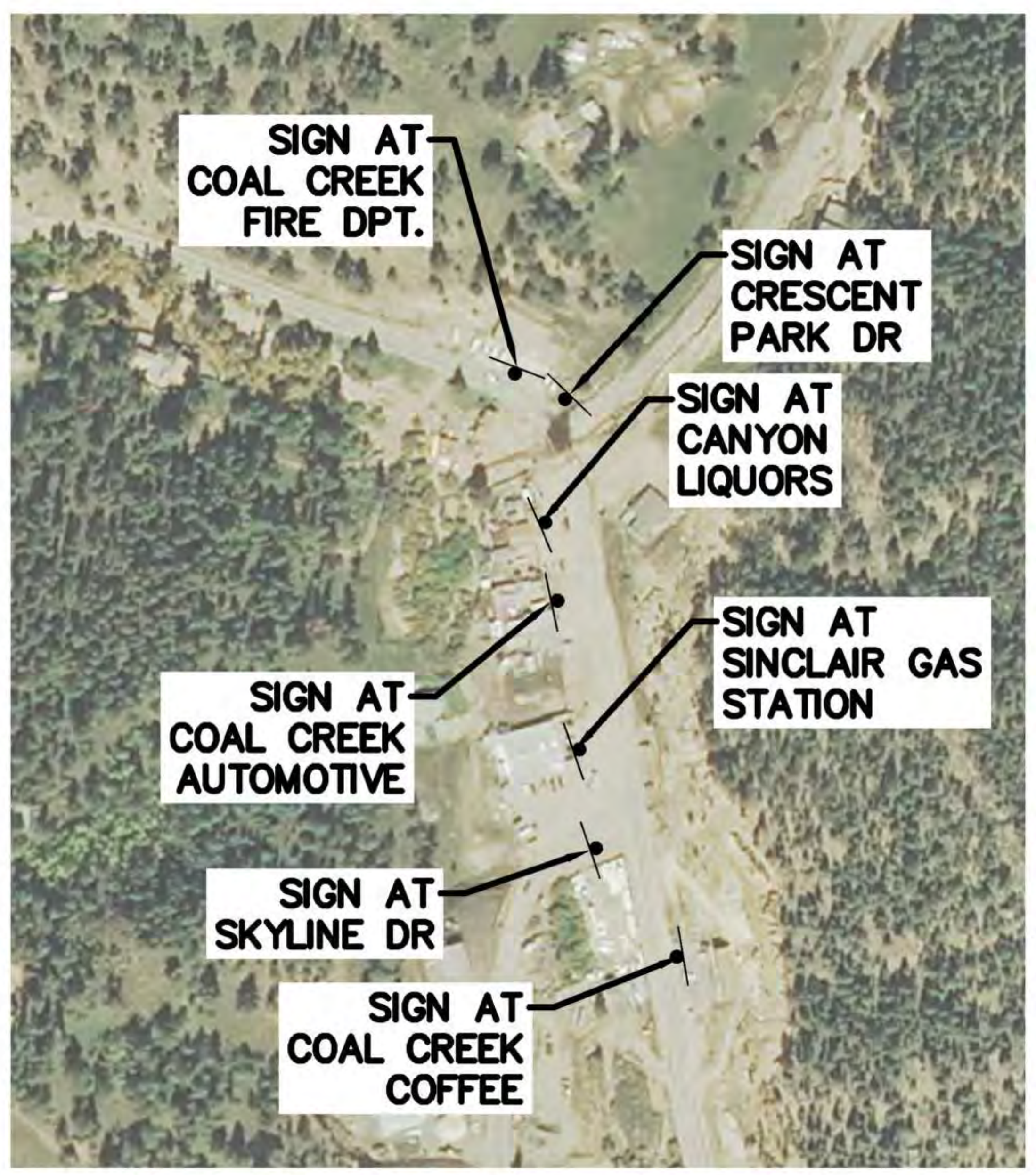
GROSS RESERVOIR EXPANSION PROJECT	GROSS DAM SIGNAGE DETAILS PART 4

NOTES

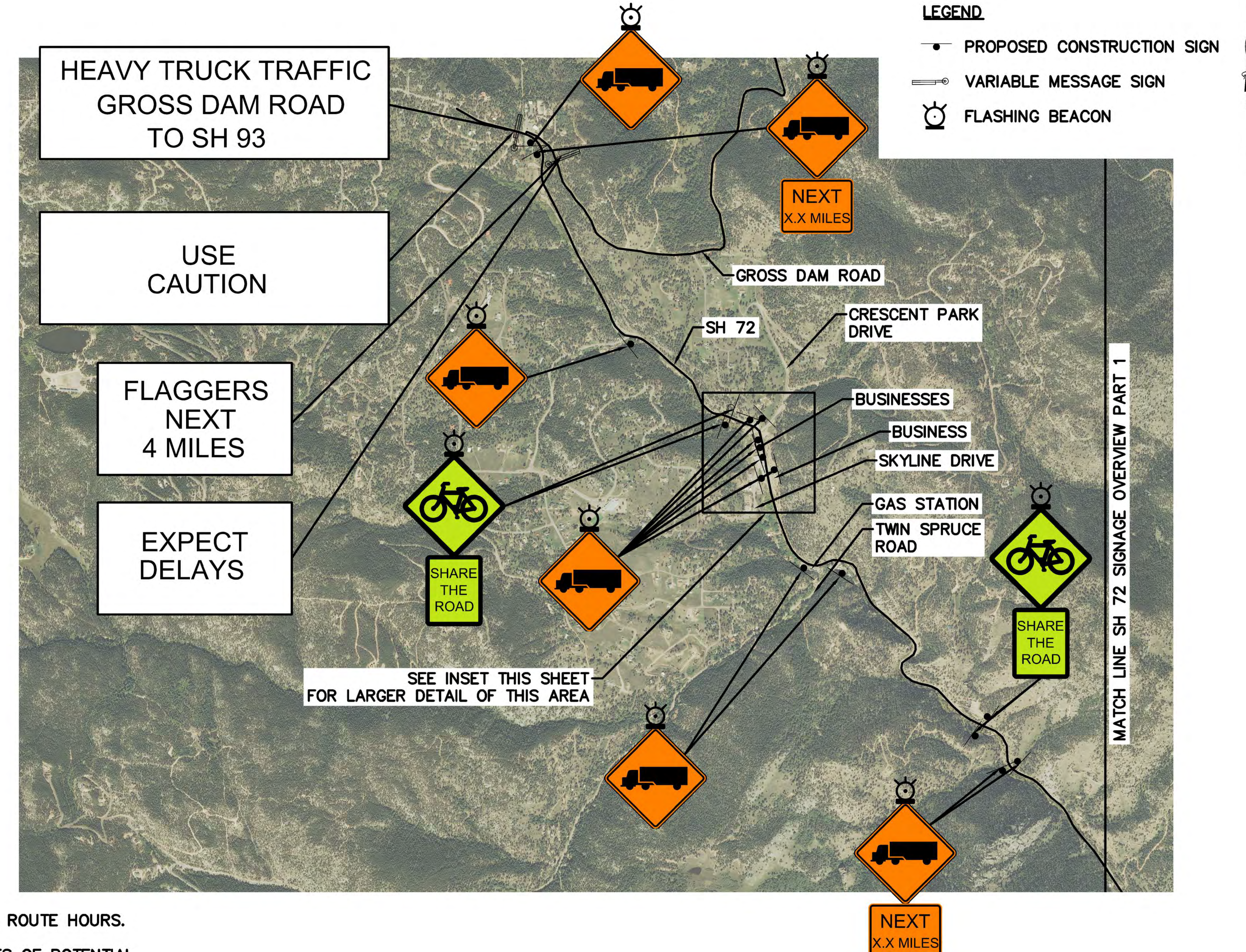
1. SIGN BEACONS ARE ACTIVE DURING HAUL ROUTE HOURS.

2. MESSAGE SIGNS DISPLAYED ARE EXAMPLES OF POTENTIAL MESSAGES TO BE DISPLAYED.

GROSS RESERVOIR EXPANSION PROJECT	SH 72 SIGNAGE OVERVIEW PART 1



INSET

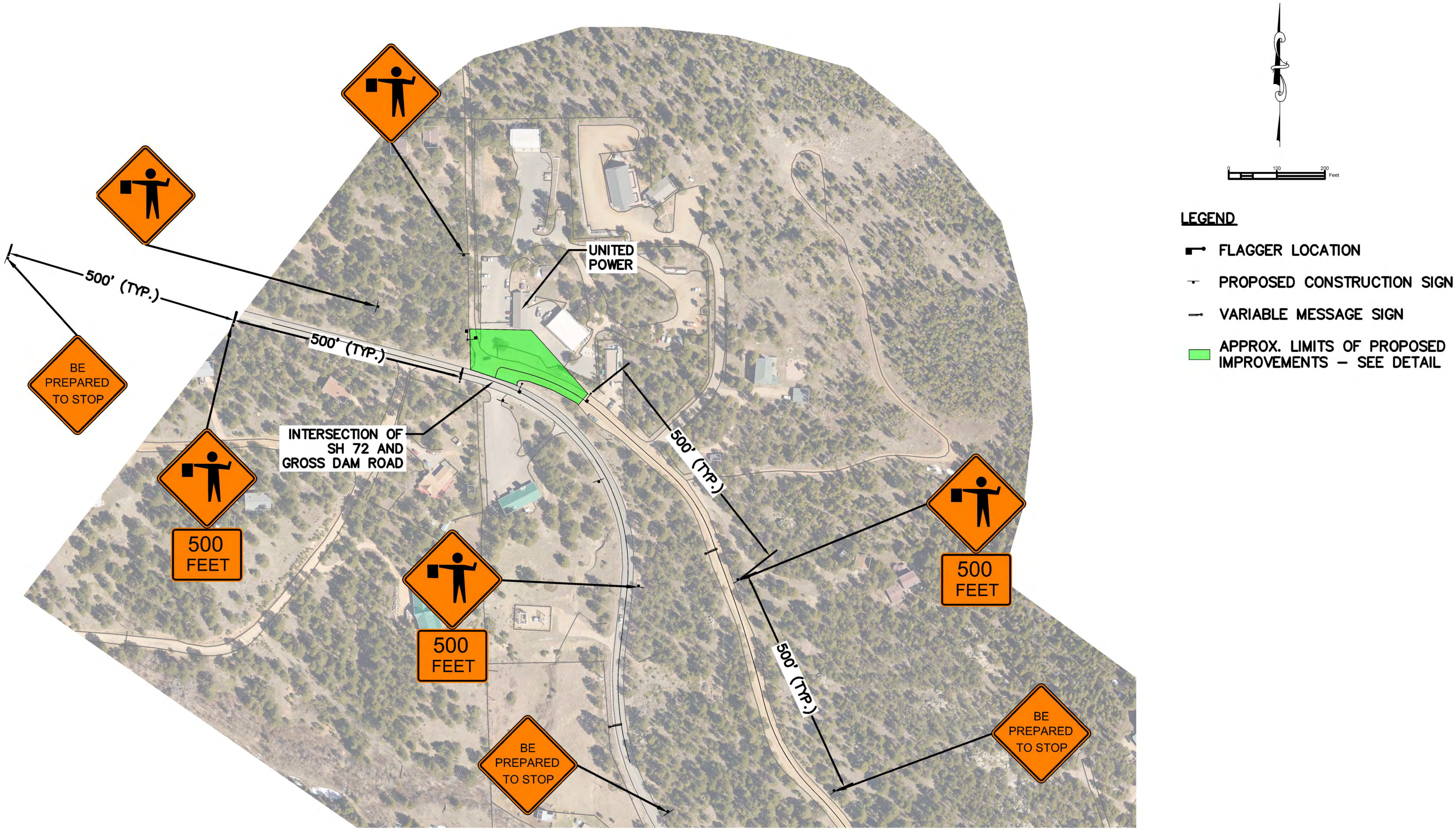


NOTES

1. SIGN BEACONS ARE ACTIVE DURING HAUL ROUTE HOURS.

2. MESSAGE SIGNS DISPLAYED ARE EXAMPLES OF POTENTIAL MESSAGES TO BE DISPLAYED.

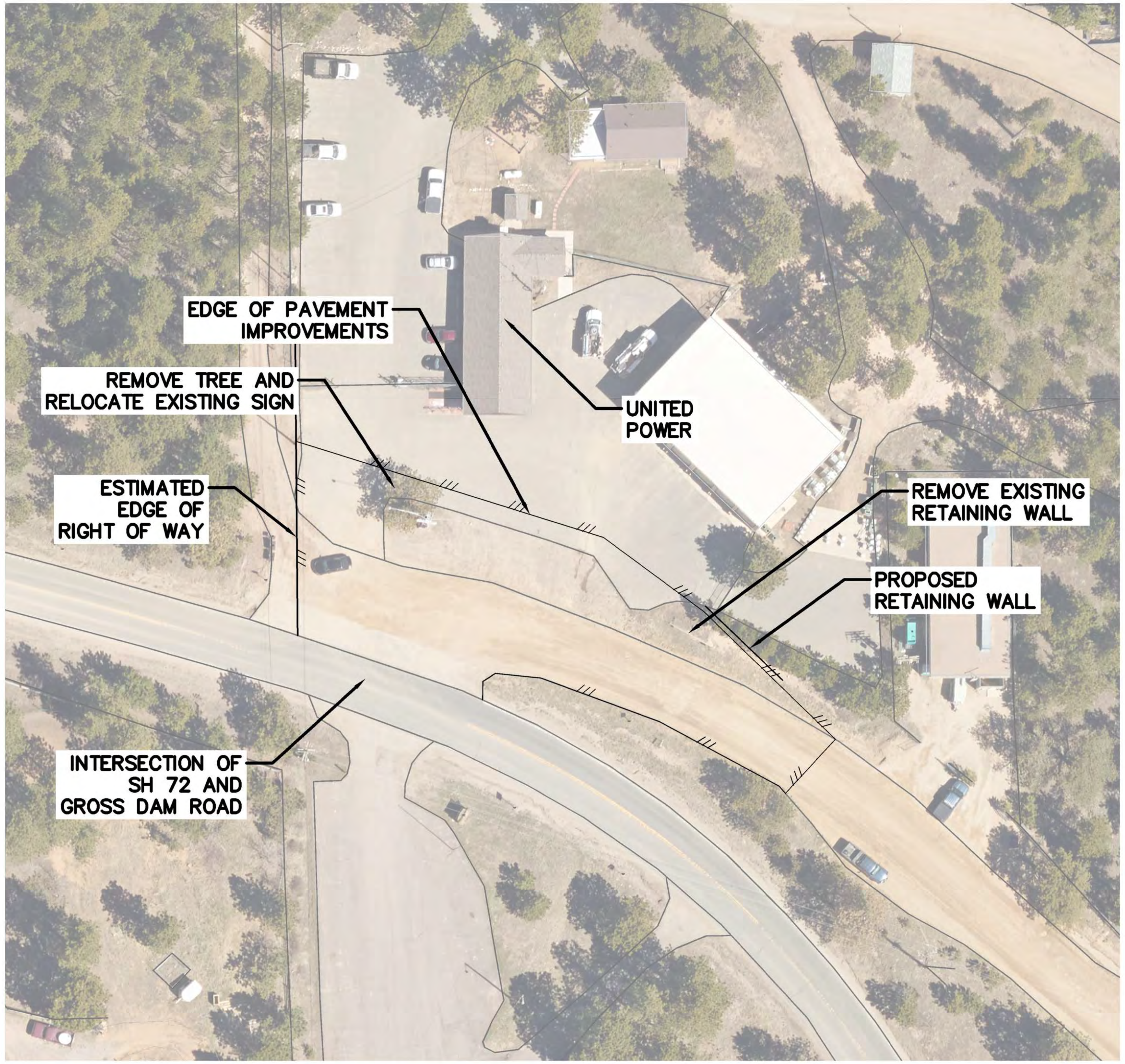
GROSS RESERVOIR EXPANSION PROJECT	SH 72 SIGNAGE OVERVIEW PART 1



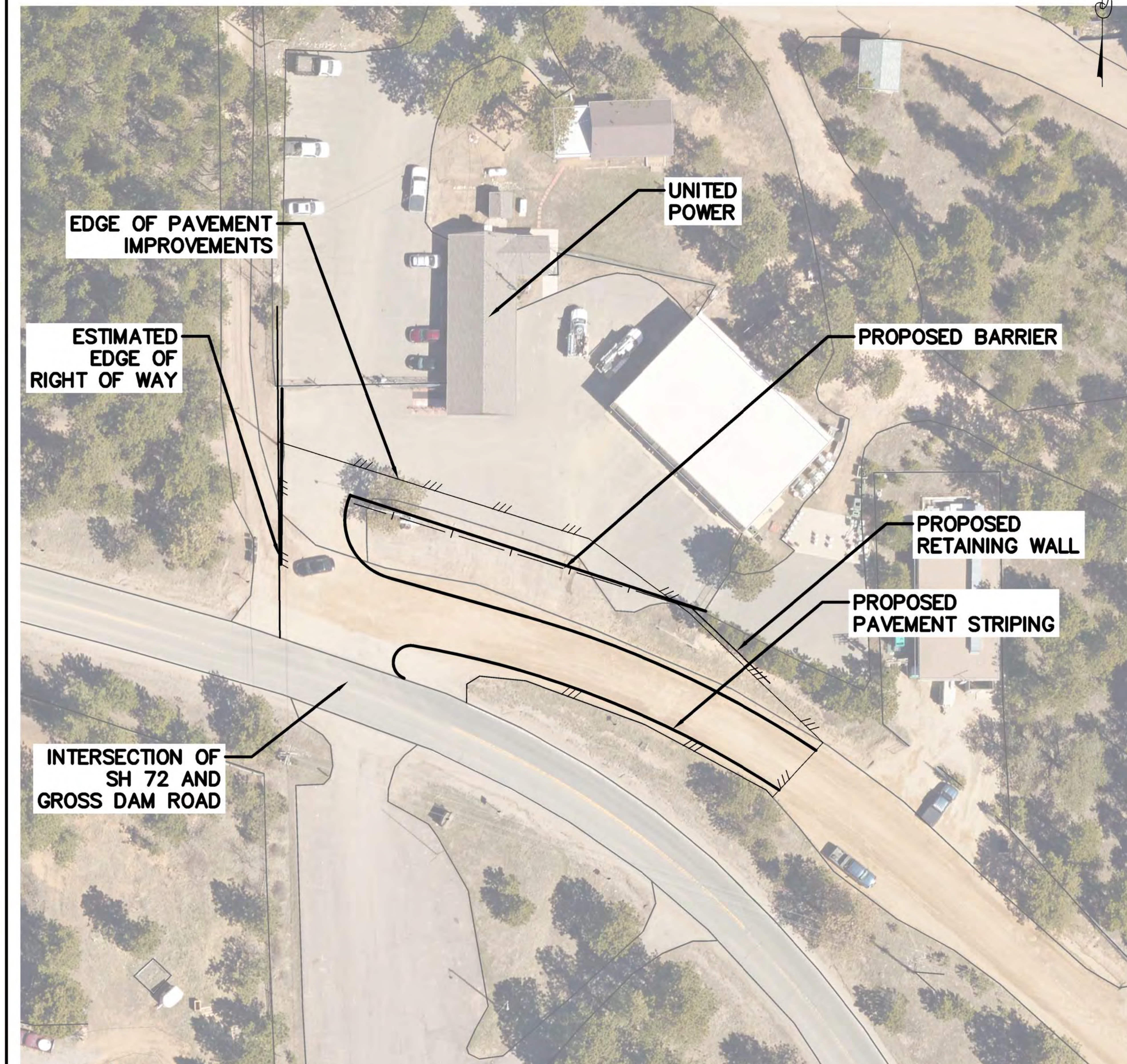
NOTES

1. FOR SIGNS NOT CALLED OUT, REFER TO GROSS DAM AND SH 72 SIGNAGE EXHIBITS.

GROSS RESERVOIR EXPANSION PROJECT	GROSS DAM AND SH 72 INTERSECTION SIGNAGE DETAILS



INTERSECTION DURING DAM CONSTRUCTION



INTERSECTION AFTER DAM CONSTRUCTION

GROSS RESERVOIR EXPANSION PROJECT

GROSS DAM AND SH 72 INTERSECTION IMPROVEMENT DETAILS

Sign Tabulation

SIGN Count	SIGN CODE	SIGN NAME	SIGN PANEL SIZE (INCHES)			BACKGROUND COLOR	FLASHING BEACON (SOLAR POWERED) ITEM NO. 614-80001	FOR CALCS NOT A PAY ITEM NO. OF POSTS	FOR CALCS - NOT A PAY ITEM MOUNTING HEIGHT	FOR CALCS NOT A PAY ITEM SIGN HEIGHT	FOR CALCS NOT A PAY ITEM BEACON SPACE	STEEL SIGN SUPPORT (2-1/2 INCH ROUND NP-40)(POST & SLIPBASE) ITEM NO. 614-01572	STEEL SIGN POST (4 INCH ROUND) (SLIPBASE) ITEM NO. 614-01554	SIGN PANEL (CLASS I) ITEM NO. 614-00011	SIGN PANEL (CLASS II) ITEM NO. 614-00012	PORTABLE MESSAGE SIGN PANEL ITEM NO. 630-80355	VARIABLE MESSAGE SIGN (GROUND MOUNTED) ITEM NO. 614-10125	REMARKS
							EACH	EACH	LF	LF	LF	LF	LF	SF	SF	EACH	EACH	
1	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 1ST CURVE FLAGGING SECTION
2	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 1ST CURVE FLAGGING SECTION
3	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 2ND CURVE FLAGGING SECTION
4	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 2ND CURVE FLAGGING SECTION
5	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 3RD CURVE FLAGGING SECTION
6	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 3RD CURVE FLAGGING SECTION
7	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 4TH CURVE FLAGGING SECTION
8	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - 4TH CURVE FLAGGING SECTION
9	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - QUEUE HOLD BEGIN/END 1
10	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - QUEUE HOLD BEGIN/END 2
11	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD AT SH 72
12	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			SH 72 AT GROSS DAM ROAD
13	W3-4	BE PREPARED TO STOP	36	X	36	ORANGE		1	7	4.25		11.25			9			SH 72 AT GROSS DAM ROAD
14	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 1ST CURVE FLAGGING SECTION
15	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 1ST CURVE FLAGGING SECTION
16	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 2ND CURVE FLAGGING SECTION
17	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 2ND CURVE FLAGGING SECTION
18	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 3RD CURVE FLAGGING SECTION
19	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 3RD CURVE FLAGGING SECTION
20	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 4TH CURVE FLAGGING SECTION
21	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - 4TH CURVE FLAGGING SECTION
22	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - QUEUE HOLD BEGIN/END 1 **- CAN BE SUBSTITUED FOR SIGN 43**
23	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD - QUEUE HOLD BEGIN/END 2 **- CAN BE SUBSTITUED FOR SIGN 44**
24	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			GROSS DAM ROAD AT SH 72
25	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		11.25			9			PRIVATE DRIVEWAY NEAR GROSS DAM ROAD AND SH 72
26	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		11.25			9			PRIVATE DRIVEWAY NEAR GROSS DAM ROAD AND SH 72
27	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			SH 72 AT GROSS DAM ROAD
28	W20-7	FLAGGER (SYMBOL)	36	X	36	ORANGE		1	7	4.25		12.75			9			SH 72 AT GROSS DAM ROAD
29	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 1ST CURVE FLAGGING SECTION **- WITH SIGN 14**
30	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 1ST CURVE FLAGGING SECTION **- WITH SIGN 15**
31	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 2ND CURVE FLAGGING SECTION **- WITH SIGN 16**
32	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 2ND CURVE FLAGGING SECTION **- WITH SIGN 17**
33	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 3RD CURVE FLAGGING SECTION **- WITH SIGN 18**
34	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 3RD CURVE FLAGGING SECTION **- WITH SIGN 19**
35	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 4TH CURVE FLAGGING SECTION **- WITH SIGN 20**
36	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - 4TH CURVE FLAGGING SECTION **- WITH SIGN 21**
37	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - QUEUE HOLD BEGIN/END 1 **- WITH SIGN 22, CAN BE SUBSTITUED FOR SIGN 43**
38	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD - QUEUE HOLD BEGIN/END 2 **- WITH SIGN 23, CAN BE SUBSTITUED FOR SIGN 44**
39	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				GROSS DAM ROAD AT SH 72 **- WITH SIGN 24**
40	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				SH 72 AT GROSS DAM ROAD **- WITH SIGN 27**
41	W16-2P	500 FEET (PLAQUE)	24	X	18	ORANGE				1.5				3				SH 72 AT GROSS DAM ROAD **- WITH SIGN 28**
42	R11-2	ROAD CLOSED CONSTRUCTION TRAFFIC ONLY	48	X	30	WHITE		1	7	2.5		9.5			10			GROSS RESERVOIR ACCESS ROAD AT THE DENVER WATER HEADQUARTERS BUILDING

43	W3-3	SIGNAL AHEAD	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - QUEUE HOLD BEGIN/END 1 **- CAN BE SUBSTITUTED FOR SIGNS 22 AND 37**
44	W3-3	SIGNAL AHEAD	36	X	36	ORANGE		1	7	4.25		11.25			9			GROSS DAM ROAD - QUEUE HOLD BEGIN/END 2 **- CAN BE SUBSTITUTED FOR SIGNS 23 AND 38**
45	W20-SPECIAL	WORK ZONE	36	X	36	ORANGE		1	7	4.25		13.25			9			GROSS RESERVOIR ACCESS ROAD AND FLAGSTAFF ROAD
46	W20-SPECIAL	WORK ZONE	36	X	36	ORANGE		1	7	4.25		13.25			9			FLAGSTAFF ROAD NEAR PROJECT PARKING LOT/STAGING AREA
47	W20-SPECIAL	END WORK ZONE	36	X	36	ORANGE		1	7	4.25		11.25			9			FLAGSTAFF ROAD NEAR PROJECT PARKING LOT/STAGING AREA
48	W16-4P	NEXT 2.2 MILES (PLAQUE)	30	X	24	ORANGE				2				5				GROSS RESERVOIR ACCESS ROAD AND FLAGSTAFF ROAD **- WITH SIGN 45**
49	W16-4P	NEXT 2.2 MILES (PLAQUE)	30	X	24	ORANGE				2				5				FLAGSTAFF ROAD NEAR PROJECT PARKING LOT/STAGING AREA **- WITH SIGN 46**
50	W16-4P	NEXT 8.6 MILES (PLAQUE)	30	X	24	ORANGE				2				5				SH 72 - **WITH SIGN 58**
51	W16-4P	NEXT 8.6 MILES (PLAQUE)	30	X	24	ORANGE				2				5				SH 72 - **WITH SIGN 75**
52	W16-4P	NEXT 5.7 MILES (PLAQUE)	30	X	24	ORANGE				2				5				SH 72 - **WITH SIGN 61**
53	W16-4P	NEXT 5.7 MILES (PLAQUE)	30	X	24	ORANGE				2				5				SH 72 - **WITH SIGN 63**
54	W16-4P	NEXT 2.9 MILES (PLAQUE)	30	X	24	ORANGE				2				5				SH 72 - **WITH SIGN 62**
55	W16-4P	NEXT 2.9 MILES (PLAQUE)	30	X	24	ORANGE				2				5				SH 72 - **WITH SIGN 64**
56	W11-10	TRUCK	36	X	36	ORANGE		1	7	4.25		11.25			9			FLAGSTAFF ROAD NEAR PROJECT PARKING LOT/STAGING AREA
57	W11-10	TRUCK	36	X	36	ORANGE		1	7	4.25		11.25			9			FLAGSTAFF ROAD NEAR PROJECT PARKING LOT/STAGING AREA
58	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 10.8
59	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			PLAINVIEW ROAD AT SH 72
60	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			BLUE MOUNTAIN ROAD AT SH 72
61	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 13.6
62	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 13.6
63	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 16.6
64	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 16.6
65	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			TWIN SPRUCE ROAD AT SH 72
66	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			CAR CARE GAS STATION
67	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			COAL CREEK COFFEE
68	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			SKYLINE DRIVE AT SH 72
69	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			SINCLAIR GAS STATION
70	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			COAL CREEK AUTOMOTIVE
71	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			CANYON LIQUORS
72	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			CRESCENT PARK DRIVE AT SH 72
73	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			COAL CREEK FIRE DEPARTMENT
74	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			RANCH ELSIE ROAD AT SH 72
75	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 19.3
76	W11-10	TRUCK	36	X	36	ORANGE	1	1	7	4.25	1		12.25		9			COMMUNITY HALL
77	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 12.6
78	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 12.6
79	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 14.7
80	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 14.7
81	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 16.8
82	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 16.8
83	W11-1	BICYCLE	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 18.1
84	W11-1	BICYCLE (EXISTING)	36	X	36	FLUORESCENT YELLOW-GREEN	1	1	7	4.25	1		14.25		9			SH 72 AT ABOUT MILE MARKER 18.1. EXISTING SIGN, NEW FLASHING BEACON AND POST.
85	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 77**
86	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 78**
87	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 79**
88	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 80**

89	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 81**
90	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 82**
91	W16-1P	SHARE THE ROAD (PLAQUE)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 83**
92	W16-1P	SHARE THE ROAD (PLAQUE) (EXISTING)	18	X	24	FLUORESCENT YELLOW-GREEN				2				3				SH 72 - **WITH SIGN 84.** EXISTING SIGN.
93	SPECIAL SIGN 1	DENVER WATER RATES AT WORK	48	X	30	WHITE		1	7	2.5		9.5			10			GROSS RESERVOIR EXPANSION PROJECT: DENVER WATER RATES AT WORK
94	PERMANENT VMS 1	N/A	N/A	X	N/A	N/A											1	SEE EXHIBITS FOR MESSAGE SUGGESTIONS
95	PERMANENT VMS 2	N/A	N/A	X	N/A	N/A											1	SEE EXHIBITS FOR MESSAGE SUGGESTIONS
96	PORTABLE VMS 1	N/A	N/A	X	N/A	N/A										1		SEE EXHIBITS FOR MESSAGE SUGGESTIONS
						TOTALS WITH QUEUE HOLD	27	N/A	N/A	N/A	N/A	410.75	358.75	97	560	1	2	
						TOTALS WITHOUT QUEUE HOLD	27	N/A	N/A	N/A	N/A	413.75	358.75	103	560	1	2	

Notes

1. Assumed post length for the 2.5" round posts did not include the slipbase length; assumed that was incidental to the item.

2. Only one 4" round pipe item was available from CDOT - assumed this was the post to match the posts required with flashing beacons.

3. Assumed a 7' mounting height. S Standards provide for a range on rural roads from 4'-8'.

4. Used a contingency to cover electrical/communication work required for this system.

Memo on Curve Flagging and Vehicle Queue Hold Delay

December 16, 2015

Memo Summarizing Curve Flagging and Vehicle Queue Hold Expected Delays

The following table provides information on the expected estimated delay at each curve flagging zone and vehicle queue hold. The following assumptions were made to calculate the estimated delays:

- A maximum of three trucks would stack up at any one time.
- The AASHTO WB-50 truck length of 55' was appropriate to use for this estimate.
- Trucks will maintain a minimum of 30' between other vehicles.
- Trucks will travel at a minimum of 10 mph through the one-way traffic zones.
- The length of the zone was measured at the centerline of the roadway.
- The worst case delay is assumed. The worst case is, for example, a car arriving in the southbound direction on Gross Dam Road at the beginning of a curve flagging zone at the same time that trucks moving in the northbound direction are given the okay to proceed. The car must wait for the trucks to travel the entire zone before proceeding.

Refer to the exhibits in the appendix for specifics on where the curve flagging and vehicle queue hold areas are.

Location	Length (ft)	Expected Estimated Delay
Curve Flagging 1	466	Less than 1 minute
Curve Flagging 2	1142	~1.5 minutes
Curve Flagging 3	318	Less than 1 minute
Curve Flagging 4	2590	3.2 minutes
Vehicle Queue Hold	7048	8.3 minutes
Combined Delay-SH 72 to Flagstaff Road	N/A	14.5 minutes
Formula: (Length of location + length of truck x 3 + length of space between trucks x 2) / 10 mph * (1 mile/5280') * 60 min/hr		