Evaluation of Natural Springs and Water Diversion Infrastructure:
Wingate and Bryant Ranch Area, Mt. Baldy, California

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Introduction

Purpose and Objectives
This report aims to: (1) Characterize the natural springs that supply water to Wingate Ranch and Bryant Ranch, and (2) Analyze the water diversion infrastructure in context of potential future upgrades. There has been a recent proposal to divert water to a new storage tank located on the Wingate Ranch property. This document also assesses the potential impact of such diversions.

Primary objectives of this study are to:
1. Map the natural springs and related stream channels from their points of origin to ultimate confluence with San Antonio Creek
2. Map, photograph and describe the existing water diversion infrastructure
3. Quantify the flow rate in gallons per minute at key places in the water system over a period of three months
4. Use contemporary computer and GIS technology to create a series of maps that illustrate the local hydrology and water supply system
5. Evaluate the feasibility of diverting additional water to the new water tank

The map products associated with this report are presented in several formats. Plates A, B, C and D have been pasted into the Appendix section below and are printed out at letter size with a hard copy of this document. The document is also saved on a CD along with PDF copies of the individual maps such that all images (plates, photos, tables and graphs) can be viewed electronically and enlarged or printed as needed. Finally, a few hard copies of the Plates are printed at poster size to facilitate viewing of the finer details.

Location of Study Area
Wingate and Bryant ranches occupy approximately 55 acres of privately owned riparian land along a perennial segment of San Antonio Creek about 1/2 mile south of Mt. Baldy village (Figure 1). The geographic base for my hydrologic study is property map of Wingate Ranch, originally surveyed in 1947, provided by Mr. Richard Wingate. Part of this map was resurveyed in 1981 when the property was subdivided into Wingate Ranch and Bryant Ranch. The 1981 map denotes survey markers and trend lines used to precisely locate important hydrologic features. The adjacent property to the north is Mt Baldy School, originally deeded to Scripps College of the Claremont College system. To provide perspective of the study area to local physiographic features, Figure 1 shows the property map overlaid onto the USGS 7.5 minute Mt. Baldy topographic quadrangle.

Several springs discharge from the hillside a few hundred feet east of San Antonio Creek. These springs flow year around and follow a convoluted network of small stream channels that eventually drain into San Antonio creek. The largest group of springs is tapped to provide domestic water supply to both Wingate and Bryant Ranch. Historically these springs have recorded a robust flow that is sustained even through periods of drought. Their location
down gradient from a sharp bend in Kerkhoff Canyon (east side of Figure 1) is not coincidental, as I discuss later in this report.

Figure 1. Location of the Wingate Ranch property map in relation to Mt. Baldy Village and nearby physiographic features. Numbered red dots indicate observation stations described in this study (see Table 2) whose locations were determined with a GPS receiver.

Methods

I conducted the hydrologic mapping and water flow measurements between mid June and early October of 2011. The general procedure entailed walking the property (accompanied by property owner Richard Wingate), making observations or flow measurements at various locations, and keeping a descriptive log in my field notebook. Locations of each observation site were determined with a Garmin GPS receiver, using the UTM projection and NAD27 Zone 11 datum compatible with the USGS Mt. Baldy 7.5 minute topographic map. Precision of these locations varied between ±9 ft and ±21 ft (Table 2). Station locations with error circles are plotted in map view on Plate A in the Appendices.
Hydrologic features and details of the water diversion infrastructure are mapped on Plate B and illustrated with photographs in the text below.

To precisely georegister the original Wingate Ranch property map in the same geographic reference frame as the topographic base map and the station locations, Richard helped me find six of the original survey points noted on the property map. UTM coordinates of these locations were determined within ±9 ft. By manipulating the ArcGIS software program, I was able to directly superimpose the observation stations and Wingate property map onto the USGS topographic base map. I utilized another program, Adobe Illustrator, to color-enhance and annotate the many features observed during this study.

Water flow measurements were accomplished with the assistance of Mr. Wingate, using either the “Bucket Catch” method or the “Velocity-Area” method. Our objective was to monitor the flow rate (also known as “discharge”) in gallons per minute (gpm) for several gauging stations over a time period of three months. The Bucket Catch method entailed capturing the full stream of water exiting a pipe with a 5 gallon bucket (see Figure 17). We used a stopwatch to measure the time (in fractions of seconds) to fill the bucket. The average of 5 to 8 bucket-fill times was calculated at each station, typically yielding a standard deviation of less than 5%. From this volume-time data, the flow rate in gpm is calculated using the formula:

\[
\text{Discharge} = \frac{5 \text{ gallons}}{\text{Average Fill Time (in sec)}} \times 60 \text{ sec per minute}
\]

The Velocity-Area method was applied at gauge locations where the entire flow could not feasibly be caught with a bucket but could be focused into a narrow stream channel. In these places I measured the average stream velocity in feet/second, using a velocity flow probe manufactured by Global Water Instrumentation, Inc. The dimensions of the stream channel were then measured with a ruler, and the area calculated in square feet. Flow rate or discharge in cubic feet/second (cfs) is related to velocity and area by the equation:

\[
\text{Discharge} = \text{Velocity (in ft/sec)} \times \text{Area (in ft}^2\text{)}
\]

The flow rate in cfs is converted to gpm by applying the conversion factor: 1 cfs = 448.8 gpm

**Observations and Results**

**Field Notes and Site Descriptions**

All field mapping observations are compiled in an Excel data table (Table 2) included in the Appendixes. Each observation station is identified as a specific waypoint number, with UTM coordinates provided in units of meters, and precision of most locations noted. A short description of the observed feature is briefly summarized. More detailed descriptions are provided in the text of this report and illustrated visually on the hydrologic map of Plate B. Although elevations are noted for most stations, these values should be considered very
approximate because they are based on a non-calibrated barometer contained in the GPS receiver. Barometric pressure may vary from day to day or with time of day or even between valley bottoms and hill slopes. To determine precise elevation with a barometer, one must frequently return to a station of known elevation and recalibrate the instrument. This was not done here.

Map Products

Locations of all observation stations (waypoints) are plotted on the Wingate property map (Figure 1 and Plate A). Also plotted on Plate A are error circles to illustrate possible deviation of absolute location for each point. The smallest circles have a radius of 9 feet corresponding to a location precision of ±9 ft. The largest circle represents a precision of ±21 ft. If precise location of a particular station is an issue, the reader may consult my field notes in Table 2 and the corresponding map location to make an evaluation.

The hydrologic maps of Plates B and C are the primary visual products of this report. They serve as the base for orienting the reader with respect to the following descriptions of the hydrologic features and stream flow gauges. These maps illustrate the main springs on the property and their connection to stream channels that feed San Antonio Creek or diversion structures that supply water to the two ranches. Also mapped are stream gauging locations, significant trails and a dirt road that provides access, and various other features of interest. Plate B shows the hydrologic map overlaid onto the Mt. Baldy topographic map. Plate C is the same map without the topography layer.

Plate D shows the Wingate property map in relation to geologic features located up gradient to the east. This geologic map draws upon my investigations in Kerkhoff Canyon area during the early 1990s. Although Kerkhoff Canyon was not revisited during the current study, this drainage has important implications for the sustainability of spring flow on the Wingate property (see discussion below).

Primary Source Springs

Two separate clusters of significant springs occur on the property and are mapped as “Wingate Springs” and “Garden of Eden Springs” on Plate B. Both sets of springs discharge from porous and permeable landslide deposits that form a steep hillside east of San Antonio Canyon. Both appear to be hydraulically connected to a perpetual water source in Kerkhoff Canyon to the east (this relationship is discussed later). The Wingate-Bryant water diversion system directly taps Wingate Springs which is the larger of the two spring sets.

I mapped three separate source springs in the vicinity of Wingate Springs. These springs discharge along a line at approximately the same elevation. There may be an additional small spring to the south, but thick brush impeded investigation in that area. The centermost of the three springs (Figures 2-3) has the greatest volume of flow. This water source has long been utilized for water supply, as evidenced by an old concrete spring box located about 50 feet downstream and a pipe that feeds water into the stream channel below. The two springs mapped to the north and south drain into tributary channels that join the main channel.
Figures 2 and 3. Two views of the centermost spring that constitutes the main source of Wingate Springs.

Figure 4. Eden Stream flows down a steep escarpment at Waypoint 58. Garden of Eden Springs discharge from ground 150 feet upslope to the east. Note roots of large cedar tree.
Garden of Eden Springs, located in the north part of the property, were apparently named for the lush vegetation and a substantial grove of tall cedars that occur in this area. I identified two separate source springs that discharge from the ground directly upslope from the Cedar Grove. These springs feed a small stream channel (“Eden Stream”) that drains westward down a steep escarpment to a confluence with San Antonio Creek (Figure 4). From visual inspection, the flow rate of Garden of Eden Springs is much lower than that of Wingate Springs. Nevertheless, the wet ground and extensive phreatophytic vegetation attest to existence of a significant water source in this area. A line of tall cedars continues several hundred feet north of Garden of Eden Springs, indicating that the shallow water source follows a north-south line.

**Upstream to Downstream Description of Natural Water Flow and Diversion**

We now focus on details of the natural and man-made hydrologic system that supplies water to Wingate and Bryant ranches. The reader is referred to my field notes (Table 2) and hydrologic maps (Plates B and C) as I describe the disposition of flow paths from highest elevation to lowest. The photographs presented below provide additional visual context.

The pristine groundwater discharged at Wingate Springs directly feeds into the water diversion system. Individual tributary channels derived from three mapped springs converge into one primary stream channel (labeled “Wingate Stream” on the hydrologic map) that flows west down a steep slope and then begins to meander to the southwest as it enters a
lush meadow. Much of this surface flow originates at the center spring (Figures 2-3). At Waypoint 442, part of the flow in the primary stream is channeled into a 6 inch PVC pipe by means of a crude V-shaped funnel structure. A coarse wire screen prevents entry of debris. This site is labeled “Catch Dam” on Plate B. Captured water is fed via the PVC pipe directly into the north end of a 5 ft x 6 ft x 4 ft deep concrete box (Figure 5), referred to hereafter as the “Upper Spring Box.” A large fraction of surface flow in Wingate stream is not captured. This water follows a channel that bypasses the Upper Spring Box on its east side (Figure 6).
The Upper Spring Box serves as a settling tank that collects sediment from the incoming spring water before feeding a pipeline to the Lower Spring Box. The photographs of Figures 7-10 show how this is accomplished. The inflow derived from Wingate Springs spills out of the 6 inch PVC pipe into the bottom of the Upper Spring Box. A pool of water rises to the top of a screened outlet pipe that is set vertically into the base of the box. When inflow is less than the maximum capacity of the outflow pipe, the pool remains at this level as water feeds into the outlet pipe. This was the case during my period of observation between June and September of 2011. When inflow is greater (typically during high-flow periods of winter or spring runoff) the water level rises to the bottom of a rectangular spillway in the east wall of the box. Excess water is thus diverted to the side of the box to join the bypass channel.

Downhill from the Upper Spring Box, water derived from Wingate Springs follows one of two paths. The significant portion not captured by the Catch Dam bypasses the Upper Spring Box and follows a well-developed stream channel that heads southwest, then south, then northwest. The resulting stream (Figure 22), labeled “North Stream” on Plate B, eventually flows westward over a steep escarpment to the point where it joins San Antonio Creek (Figure 23). An undetermined amount of water associated with North Stream seeps out to the sides and contributes to several extensive boggy areas southwest and south of the Upper Spring Box. Meanwhile, a 4.75 inch external diameter transite pipe carries water from the outlet pipe of the Upper Spring Box southwestward to the Lower Spring Box. This pipe exhibits significant leaks in 5 places that are located with red circles on Plate B. Figures 11-13 illustrate several of these leaks in various states of repair. The leaking pipe contributes water to a separate stream channel (“South Stream”) that flows westward into San Antonio Creek. South Stream also derives significant flow from natural groundwater seepage out of the extensive boggy area mapped southwest of the Upper Spring Box.
The Lower Spring Box (Figures 14-15) serves as storage tank that feeds water downhill to Bryant Ranch and Wingate Ranch. Water flows from the 4.75 inch transite pipe into the top of the 8 ft x 7.5 ft box through a coarsely screened opening. A 2-inch diameter iron pipe exits the lower southwest corner of the box (Figure 20) and ties into sprinkler and plumbing infrastructure at the two ranches. Meanwhile, significant flow bypasses the north side of the Lower Spring Box in the well-developed channel of South Stream. Water in this stream is derived from pipe leakage upstream and natural groundwater seepage from the edge of the boggy area to the northeast. Water not utilized for domestic purposes spills out of a notch in the northwest corner of the spring box. This excess water adds to the flow in South Stream.
Downstream from the Lower Spring Box, South Stream crosses under the dirt access road via a 24 inch diameter culvert (Figures 16-17). The stream continues west across a boulder flood plain to its confluence with San Antonio Creek. Water flow through the culvert represents a large volume of Wingate Springs runoff not utilized for domestic purposes. Additional unutilized flow, also derived from Wingate Springs, is represented by the runoff in North Stream (described above).

**Figure 16.** Taking a GPS reading at the Lower Culvert gauging site on June 28  
**Figure 17.** Using the “Bucket Catch” method to gauge flow at Lower Culvert site on September 8

### Summer 2011 Flow Data

**Description of Gauging Stations**

Several gauging sites were established in mid June of 2001 and measured systematically through mid September. These gauging stations are located on Plates B and C and illustrated with photographs below. The Wingate Springs Inflow station (Figure 18) was measured with the Velocity-Area method where Wingate Stream is constricted between two rocks about 3 ft upstream from the Catch Dam. The Upper Spring Box Bypass Station (Figure 19) was likewise measured using the velocity probe. To quantify the flow captured by the Upper Spring Box (and diverted into the outlet pipe) flow, we directly measured the high velocity stream exiting the white PVC pipe (Figure 20), again applying the Velocity-Area method. These three gauges
allowed me to determine how water flow derived from Wingate Springs is divided between the bypass stream and the primary diversion pipe.

I established three additional gauging sites to monitor flow relationships below the Upper Spring Box. Water exiting the Lower Spring Box (Figure 21) was measured using the Bucket method. The Lower Culvert Station (Figures 16) was most accurately measured with the Bucket method (Figure 17). I also attempted the Velocity-Area method with the velocity probe, but the cross sectional area of the culvert outflow stream proved to be highly irregular due to dents in the culvert, leading to significant error. Finally, I was able to find a site on North Stream (Figure 22) that was suitable for the Velocity-Area method.

Figure 18. Wingate Springs Inflow gauging station. Measurements were taken at the constriction between rocks about 3 ft above the Catch Dam

Figure 19. Upper Spring Box Bypass gauging station; flow was measured along the gravel-lined channel at the top center

Figure 20. Upper Spring Box Outflow gauging station. Flow exiting the white pipe is equivalent to outflow from this spring box

Figure 21. Lower Spring Box Overflow gauging station. Water from the spillway was captured with a 5 gallon bucket. Note pipe at right corner that feeds water to Bryant and Wingate ranches
Flow Data Table and Corresponding Graphs

The results of all flow measurements from summer 2011 are presented in Table 1, with corresponding graphs of flow versus time charted in Figure 23. This chart is useful for visually comparing flow rates between all of gauging stations described above. Measurements at two of the gauges (Wingate Springs Inflow and North Stream were not initiated until July 17, but these stations are important for quantifying how flow is partitioned downstream.

A common theme of this report is that there is a great excess of water not being utilized for domestic purposes. The Lower Culvert and North Stream gauges provide quantitative evidence of this excess flow; further qualitative perspective is provided by the photographs of Figures 16, 17, 22 and 23.
Table 1: Wingate Ranch Flow Data: Summer, 2011

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<th>Upper Spring Box Bypass</th>
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<th>North Stream</th>
<th>Lower Spring Box Overflow</th>
<th>Lower Culvert</th>
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Flow at Wingate Springs and Related Water Diversion System: Summer, 2011

Figure 24. Results of flow measurements from multiple gauging sites on Wingate and Bryant Ranches, charted over the Summer 2011 period of observation
Interpretation and Discussion of Results

Partitioning of Water Quantity Through the Flow / Diversion System

The graphs in Figure 23 are useful for describing the proportioning or partitioning of water as one walks down gradient from the Wingate Springs source to the ultimate points of discharge into San Antonio Creek. Because I did not measure flow at Garden of Eden Springs, I cannot comment on their significance other than the flow rate appears to be much lower (although not trivial) than that associated with Wingate Springs. Likewise, there is an uncertain amount of distributed groundwater seepage in the boggy areas between North Stream and South Stream that was difficult to directly measure. All gauging sites were selected to acquire data where the majority of flow was constricted into a narrow channel.

The Wingate Springs Inflow gauge is a good measure of the total amount of water available for diversion down gradient. A minor quantity of distributed seepage from the adjacent water-saturated ground was not measured in the primary channel; this may eventually contribute to North Stream and South Stream that carry runoff into San Antonio. The highest flow rates in the study area (299 to 341 gpm) were recorded at the Wingate Springs Inflow gauge.

Two gauges at the Upper Spring Box provide information about partitioning of flow when compared to Wingate Springs Inflow. In general the sum of Upper Spring Box Bypass and the Upper Spring Box Outflow is approximately equivalent to Wingate Springs Inflow. The Upper Springs Bypass gauge records the amount of flow not captured and diverted toward the Lower Spring Box. This bypass flow becomes North Stream and eventually makes its way down hill to North Stream Gauging Station. The North Stream station usually recorded higher flow than the Bypass gauge, indicating that some groundwater seepage has added flow between the two sites. The Upper Spring Box Outflow station recorded between 59% and 74% of the value of Wingate Springs Inflow gauge. Comparison of these two gauges provides a good measure of how well the source spring flow is captured by the Upper Spring Box.

The pipeline leading from Upper Spring Box to Lower Spring Box is leaking in the 5 places noted on the hydrologic map (Plate B). These leaks are the primary reason for the consistently lower flow recorded at the Lower Spring Box Overflow gauge. Comparison of Upper Spring Box Outflow and Lower Spring Box Overflow shows that that 110 to 164 gpm was lost between these two points of measurement during the Summer of 2011. This loss cannot be due to actual diversion from Lower Spring Box to Wingate and Bryant Ranches. Domestic water usage was not measured during this study but is estimated to average only a few gpm, perhaps 20-30 gpm when the sprinklers are running. During the times of flow measurement, the Bryant Ranch sprinkler system that accounts for much of the domestic water diversion, was not operating.

The Lower Culvert Gauge records runoff near the mouth of South Stream. This stream includes the overflow from Lower Spring Box, leakage from the pipeline connecting the
Lower and Upper Spring Boxes, and unmeasured natural seepage that feeds into the stream from the south end of an extensive boggy area mapped on Appendix C.

Overall these flow measurements demonstrate an abundance of water directly tied to a source at Wingate Springs. There is an excess of water not utilized for domestic purposes. The best direct measure of this excess water is the sum of flow measurements at North Stream gauge and Lower Culvert gauge. This value ranged between 239 and 257 gpm during the period of measurement. Downstream from these gauges, water is discharged into San Antonio Creek.

**Impact of Proposed Diversions to Green Water Tank**

Property owner Richard Wingate proposes to modify the existing infrastructure by diverting water from the Upper Spring Box to a 6000 gallon water tank (labeled “Green Water Tank” on Plates B and C). The tank would serve a dual role: (1) provide direct domestic water supply to Wingate Ranch along a shorter flow path with no leaks, and (2) provide a storage reservoir to support future firefighting efforts. One purpose of this study is to assess the impact of the proposed diversions on the water supply to Bryant Ranch.

The most cost-effective and efficient way to accomplish the diversion is to directly tap water from the Upper Spring Box by installing a 2-inch galvanized steel pipe with a flow regulation valve. There is sufficient elevation drop between the spring box and the water tank to provide gravity feed. A proposed route for this pipeline is shown with a green line on Plates B and C. The water tank would be fitted with an overspill drain to permit continuous circulation of water through the system at a low flow rate after the tank is full. With this simple system, a separate catch dam and spring box/settling tank would not have to be constructed.

The question of impact hinges on comparing the flow rate through the existing diversion infrastructure to the flow rate needed to sustain the proposed new diversions. It would be especially helpful to know what the actual water usage is at Bryant Ranch. Water usage has never been directly measured at either ranch but might be done with an in-line flow gauge. As mentioned earlier, typical average household water usage (both ranches combined) is estimated to be on the order of a few gpm. The main draw on the Lower Spring Box is the sprinkler system at Bryant Ranch. These sprinklers operate at full capacity during the hottest summer and fall months. A very rough guess of the maximum flow rate needed to run the sprinklers might be 20-30 gpm.

To aid in an evaluation, certain flow quantities are now known. The Upper Spring Box Outflow gauge recorded discharge between 196 and 252 gpm over 2½ summer months of 2011. This box captures approximately 2/3 of available water from the Wingate Springs inflow stream. Because of significant pipe leakage, flow rate at the Lower Spring Box Over flow gauge was much lower (65 to 88 gpm). The Lower Spring Box gauge provides a measure of the minimum amount of flow currently available to both ranches. Those values would be
much higher if the transite pipe were repaired. However, according to Mr. Wingate, repair might prove difficult due to the odd size of this pipe and its joints.

The Upper Spring Box regulates a large amount of flow that is not utilized by either ranch. Compared to the available discharge of 196-252 gpm, the flow rates needed to fill the Green Water Tank and sustain a reasonable domestic water supply at Wingate Ranch are an order of magnitude lower. Various flow scenarios may be envisioned for the proposed diversion system, with a regulator valve installed where the new line exits the Upper Spring Box such that flow rates could be lowered during times of drought. A diversion rate of 20 gpm would fill the 6000 gallon tank in 5 hours. Thereafter, a very modest diversion of 5 to 10 gpm would supply more than ample water for domestic use at Wingate Ranch. The portion of this water not utilized (probably several gpm) can be diverted to an overspill channel, allowing a continuous flushing of the water tank, similar to what occurs in the two existing spring boxes.

In other words, I believe the impact of proposed new diversions on water supply to Bryant Ranch would be minimal. The flow rates required by the new system represent about 10% of the actual available water in the Upper Spring Box.

**Hydrogeologic Explanation for Sustained, Robust Flow of Source Springs**

One of the most interesting and unexpected results to this author is the remarkable sustainability of flow rates in the Wingate Springs hydrologic system over the long dry period of the summer. At several gauges the flow actually increased with no obvious connection to a recharge event such as rainfall or thunderstorm. From my previous studies of natural springs in the Mt. Baldy area, it is typical to observe a pronounced, exponential decay of flow rate during the summer and fall months. Such is not the case with Wingate Springs. Even by mid September, most measured flow rates had not dropped off very much compared to 2 months earlier. The overall robust nature of Wingate Springs has been noticed before, as in the words of long time Mt. Baldy resident Bobby Chapman, recalled by Richard Wingate, “….strong flow, all the time.”

I believe this study area has a unique geologic setting that contributes to its unusual flow characteristics. This statement draws on my past geologic mapping of bedrock and soils in the area, and comparison to other major springs that drain similar porous and permeable landslide deposits in Icehouse Canyon and Manker Canyon. The basic mechanism I postulate is that significant runoff from a major drainage (Kerkhoff Canyon) is channeled into the landslide deposits that feed Wingate Springs, providing an almost perpetual water source. Testing of this hypothesis will require future detailed mapping in Kerkhoff Canyon that is beyond the scope of this study.

The geologic sketch map of Plate D illustrates the general concept. Wingate Springs and Garden of Eden Springs drain from the lower slopes of a major landslide deposit known locally as “Cow Canyon Landslide.” Both springs discharge from a porous and permeable conduit system that has been well developed over time. Probably these points of discharge
are located just above a buried impermeable bedrock surface (such is the case with the springs in Icehouse Canyon and Manker Canyon, but difficult to prove here). Regardless of that possibility, two large exposures of bedrock do outcrop directly north and south of the Wingate/Garden of Eden Springs. I suggest that these bedrock exposures are configured so as to create a funnel that captures runoff from the long west-trending segment of Kerkhoff Canyon. It is probably no coincidence that the springs occur directly down gradient of the point Kerkhoff Canyon takes an abrupt 90 degree bend to the south. The porous landslide deposits make an ideal medium to accept infiltration as surface water derived from Ontario Ridge tries to navigate that bend.

Conclusions

Water supply to Wingate Ranch and Bryant Ranch is accomplished by an old system of spring boxes and pipes that tap a robust water source known in this report as Wingate Springs. During the summer of 2011, 299 to 341 gpm of water flowed down a trunk stream from Wingate Springs toward the Upper Spring Box. Approximately 2/3 of this water was captured by the spring box, which serves as a settling basin to collect sediment during storm runoff. Only ¼ of the 300+ gpm made it to the Lower Spring box because of significant leakage from an old transite pipeline between the two boxes. During the period of measurement 65 to 88 gpm was actually available for water supply to the two ranches, via a 2-inch iron pipe that taps the Lower Spring Box. Much of this water was not used for domestic purposes and was returned to San Antonio Creek via “South Stream.” Meanwhile, water that physically bypasses the Upper Spring Box capture point adds to some of the pipe leakage and feeds a separate channel (“North Stream”) which also drains to San Antonio Creek.

The quantitative flow measurements and hydrologic map described in this study demonstrate a robust, sustainable water supply to Wingate and Bryant ranches, despite natural losses down gradient and significant leakage from the existing infrastructure. There is clearly an overabundance of water in this hydrologic system. A good measure of the excess water quantity is the sum of the flow recorded along North Stream and South Stream directly upstream from their points of discharge into San Antonio Creek. This value ranged between 257 and 239 gpm during the period of measurement. In comparison to the natural inflow and outflow values (about 300 gpm and 250 gpm, respectively), the few gpm of water needed to sustain the proposed new diversion system is almost trivial.

Appendices

(larger plates are provided with report for clarity)
Plate A:
Plate C:

Hydrologic Map of Wingate Ranch Area
Mt Baldy, California

Legend
- Perennial Spring
- Perennial Stream
- Spring Box
- Catchment Dam
- Water Diversion Pipeline
- Bridge
- Leak in Pipeline
- Water Tank
- Proposed New Diversion Line
- Dirt Access Road
- Trail
- Boggy Area
- Map Survey/Registration Point (located by GPS—numbered points were used to georegister map)
Plate D: