November 10, 2011

Santa Barbara County Board of Supervisors
c/o Clerk of the Board of Supervisors
105 E Anapamu Street, suite 407
Santa Barbara, CA 93101

Dear Chair and Members of the Board,

I am submitting the attached expert testimony of Dr. Curry supporting the effort of Cuyama Valley Conservancy in the Appeal of a Proposed Revision to the Previously Approved Diamond Rock Sand and Gravel Mine and Processing Facility.

Thank you for your time and attention to this matter.

Jennifer Lee

CUYAMA RIVER AGGREGATE MINING IMPACTS

INSTREAM-MINING - DIAMOND ROCK MINE

Robert R. Curry[1] PhD Watershed Systems 11-1-11

Problem Statement for this report:

In my prior geologic and hydrologic reports on the GPS and Diamond Rock Mining ventures in the bed of the Cuyama River near Ventocopa (Curry, 9-11-2008, 6-6-2009, and 5-10-2011) I have apparently not fully understood the position of the North County Planning and Development staff. My professional reports were addressed to the Santa Barbara Planning Commission and may or may not have been considered in their decisions. I now have been afforded a copy of a letter from Supervising Planner Gary Kaiser dated May 13, 2008 addressed to Sarah Bartling of RAM Environmental regarding *Continued and On Going operations at GPS Mine/Ventucopa Rock Plant Expansion 03CUP-00000-00059* (see attached). Based on the statements in this letter, I now realize that it had been the position of the County Planning staff that "*good faith*" efforts by the applicants to "*diligently pursue the necessary permits*" would permit them to expand and continue mining operations while permits were being sought. Further, Mr. Kaiser states that "*The decision to require removal of an unpermitted structure or require that a use cease until action is taken on the permit is up to the discretion of the enforcement planner in consultation with the Supervising Planner and Deputy Director based on the facts of the case and the potential for impacts to the public's health or safety of the environment. In the GPS case, there is no such potential*."

This letter was addressed to the company responsible for applications for in-stream mining permits on behalf of the two adjacent mining companies, Diamond Rock and GPS. Although the language of the last sentence is not entirely clear, it appears reasonable to assume the Mr. Kaiser is telling the applicants that their planned and ongoing operations can continue while deliberations proceed on the potential environmental impacts of the extant GPS mining operation, notwithstanding contemporary requirements of federal (U.S. Corps of Engineers) and State (Department of Fish and Game) regulatory agencies. Further, the County seems to be saying that there are no potential impacts to the public's health or the environment from the proposed in-stream mining activity.

At the present time a newly expanded in-stream mining venture by Diamond Rock mine is proposed to utilize the processing facility of the adjacent pre-existing GPS Mine. Santa Barbara County apparently proposes to approve a modified Conditional Use Permit (CUP) that will restrict active in-stream mining operations for a 5-year period to allow only one of the two proposed mine operators to mine in the channel, while

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acknowledging plans for both operations for up to 30 years of mining under the current applications.

This report challenges the May 13, 2008 opinion of Mr. Kaiser and the EIR authors that ongoing and continuing in-stream mining at the GPS and/or Diamond Rock sites will have no negative impacts on health, safety, or the well-being of citizens of Santa Barbara County. I will show that the direct effects of in-stream mining through release of sediment to the lower Cuyama River and through diversion of flows near the mine site together have costs to the agricultural communities of several millions of dollars per year.

The Final EIR for Diamond Rock Sect 3.1 p. 18 states that: *"Under CEQA, hydraulic impacts are considered adverse if they cause channel bed degradation and/or bank erosion that: 1) damage public infrastructure such as bridges or pipeline crossings; 2) damage or destroy adjacent developed land uses or structures due to bank erosion or flooding; 3) disturb, convert, or destroy valuable in-channel riparian habitat; or 4) expose people to a new flooding hazard*." (EIR 3.1-18)

Offsite Impacts not considered:

Mr. Kaiser's letter implies that the County Planning and Development staff considers that in-stream mining activities at the GPS/Diamond Rock site cannot damage public infrastructure nor have impacts to the public's health or safety of the environment. Nothing could be farther from the truth. My prior reports have focused on local upper Cuyama Valley impacts to agricultural water users and river bank stability but there are also two direct offsite and one indirect offsite deleterious impact that affect Santa Barbara County and the Santa Maria region.

The two primary offsite mining effects are the impacts of siltation in the Cuyama River valley on agricultural water uses in the Santa Maria area and impacts of siltation on lower Cuyama Valley groundwater recharge. The indirect impact is that of reduced Twitchell Reservoir storage on the ability of agencies to release flows to attract and mitigate migration of Steelhead in the Santa Maria and Sisquoc rivers. These three offsite cumulative impacts will be addressed in this report.

Silt is released directly by the mining operations when the spoils of mining are returned to the Cuyama River bed to be washed downstream in subsequent high flows, and that silt ultimately displaces storage capacity in Twitchell Reservoir, thus depriving the Santa Maria Valley of irrigation water and flows necessary for migratory federally-endangered fish. This is certainly a "damage to public infrastructure" that must be considered under CEQA. Fine sand, silt, and clay are collectively termed "fines" and may be separated from the mined aggregate in the processing area or through selective mining. They may be stockpiled temporarily if derived from processing, or moved to temporary berms surrounding the active pit or placed as fill under temporary road beds as part of the mining operations.

As silt is washed downstream from the mine site, it also impairs in-channel aquifer recharge for the agriculture of the lower Cuyama Valley in San Luis Obispo and Santa Barbara counties. Further, as silt fills the Twitchell Reservoir, it reduces the effective "conservation storage" capacity for water that will be released annually to recharge the Santa Maria aquifer. The impacts of silt transported into the lower Cuyama River are very substantial.

The EIR justifies the position of the County as explained in Mr. Kaiser's letter by stating: "*The river channel at the two mine sites is about 2,000 feet wide. There is <u>no evidence of bank erosion</u> at or above the GPS mine site, despite over 30 years of mining to depths of 90 feet. Bank erosion induced by headcutting or downstream channel degradation is not expected to occur based on the width of the river and the low depth of flows (e.g., less than one foot in a 20 year storm). However, if bank erosion were to occur near either mine site, <u>no significant impact would be expected because there are no structures located directly adjacent to the river bank</u>, and only a few agricultural fields are located adjacent to the river. There are buffer zones and bank protection along these fields, which would provide protection from localized bank erosion"* (EIR 3.1-19, <u>emphasis added</u>). Clearly, the EIR did not consider off-site impacts of sediment released as part of the processing or channel changes caused by the presence of an in-stream pit that attracts and accelerates flow.

The proposed Diamond Rock mine in-stream excavation site is located immediately adjacent to the major site of bank erosion being caused by the GPS Mine pit. That pit attracts flows because it is the lowest point in the channel. Figure 3 is taken directly from the Diamond Rock FEIR, and shows that the proposed mine site will be only 425 feet from the actively eroding west bank of the Cuyama River just below the area pictured in Plates 1 and 2 of this report. This is the most actively eroding 40-50 foot high portion of the Cuyama channel and abuts unconsolidated silt and fine sand at the Fox Mountain anticlinal axis. There could not be a more unstable site to place an in-stream mine.

Below is a portion of the Diamond Rock EIR's Figure 3.3 "Flow and Drainage": Plates 1 & 2 on page 15 are photographs taken about 900 feet upstream (south) where the blue dot-dash line is shown against the cliff face in their figure 3.3.

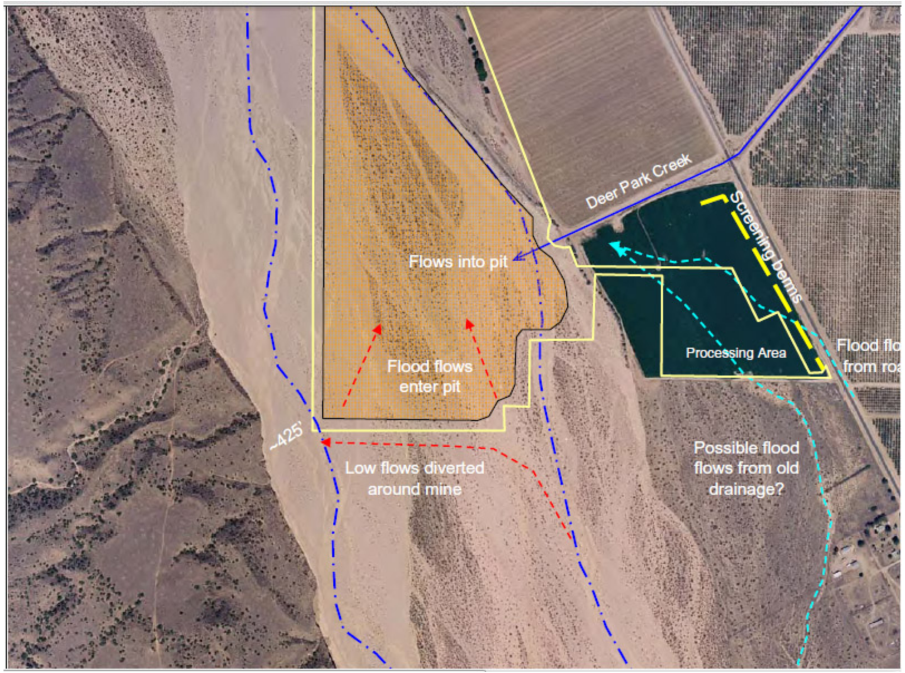

Fig 1 FEIR Fig 3.3 Flow and Drainage Diamond Rock Pit site

The FEIR would somehow have us believe that the "low flow diversion channel" would pass harmlessly around the Diamond Rock mine pit. In fact, if flows are diverted successfully around the pit, they will continue to actively erode the cliff-face shown in Plate 1. If those flows are diverted to enter the southwest corner of the pit, the accelerated downcutting of the river bed will under-cut and further destabilize the high unconsolidated bank, filling the GPS pit with silt and increasing the filling of the Twitchell Reservoir.

It is very hard to understand how the statement quoted above from the EIR at 3.1-19 could be considered as anything other than false. This collapsing cliff has been active since at least the 1998 floods and is clearly visible from Highway 33. It is pictured from the highway in a photo on the USGS Cuyama water website at: http://ca.water.usgs.gov/projects/cuyama/images/pics/Geology/IMG_0894.JPG An aerial overview that I have created from Google Earth Pro USDA Farm Services Agency aerial photos of May 24, 2009 follows:

Fig 2. Oblique View West based on aerial photos of 5-24-2009 of GPS pit and Diamond Rock site just upstream. A three mile length of river-bed is shown. Santa Barbara Canyon is the major tributary entering from the west. Highway 33 in the foreground. Vertical exaggeration 3X. The 50-foot cliff shown in Plate 1 is near the left margin. In these late May 2009 photos there is water and active flow into the GPS pit and active erosion of the west-bank cliffs. See Plate 1 for scale.

SANTA MARIA VALLEY IMPACTS

Twitchell Reservoir was funded by Congress in 1954 primarily to provide 20,000 acre-feet of water annually for agricultural use in the Santa Maria Valley. Although partly justified as such, it is not a significant flood control structure and does not divert water to irrigation facilities. It is essentially a single-use federally funded U.S. Bureau of Reclamation facility, designed and built by the Corps of Engineers to release water into the Sisquoc and Santa Maria rivers for direct groundwater recharge to the open Santa Maria Valley aquifer. The objective of the project is to release regulated water from storage as quickly as it can be percolated into the Santa Maria Valley ground-water basin. Therefore, Twitchell Reservoir is empty much of the time, and recreation and fishing facilities are not included in the project.

Construction of Twitchell Dam was started in July 1956 and completed in October 1958. Twitchell Reservoir impounds winter floodwaters for later release down the Sisquoc and Santa Maria river channel at a predetermined rate for maximum percolation into the ground-water reservoir (USBOR, Twitchell website, updated May 17, 2011).

Original Corps of Engineers design studies estimated that 40,000 AF of sediment would accumulate in the reservoir during the first one hundred years of operation. In 1981, a study found that the rate of sedimentation was about 70% greater than the original estimate. As of 1998, the accumulated sediment had reached an estimated 44,000 AF. Because of this, the Santa Barbara County Water Agency (SBCWA) and the Santa Maria Valley Water Conservation District began studies for a sediment management plan. Part of that effort resulted in an initial report titled *Twitchell Project Manual April 23, 2010* prepared by consultants (Twitchell Management Authority, 2010). That report is the basis for the following conclusions:

Economic Impacts of Silt in the Cuyama River

An obvious impact of silt deposition in the bed of the river is reduced groundwater recharge. Reduced recharge contributes to increased groundwater deficits and thus increased costs for agricultural production in the Cuyama Valley where almost all agriculture is based on pumped groundwater. This impact is the focus of the U. S. Geological Survey's on-going Cuyama Valley Project under the direct of Randy Hansen.

A less obvious impact is that of decreased storage capacity in the Twitchell Reservoir. The Twitchell Management Authority (TMA) estimates that silt sedimentation displaces an average of 1200 ac-ft of potential irrigation water per year based on the accumulated volume of 42,357 ac-ft (as of 2007). The capacity of the reservoir has continued to be reduced due to sedimentation. The total sediment below the spillway (elev. 651.5) in 2007 was 42,357 acre-feet, which is a reduction of storage in the original (1958) 110,000 ac-ft conservation storage allocation of 26.3%. Sediment now fills the reservoir eliminating any capacity to the 524-foot elevation. This is significantly more than the 100-year sediment level of elevation 504 predicted by the designers in 1953 (TMA 2010). At the water conservation storage elevation of 623 (water conservation storage elevation boundary), the capacity had changed from 112,205 acre-feet in 2000 to a 2007 capacity of 110,482 acre-feet. For the initial 41 years of operation the average sedimentation rate was about 1,730,000 cubic yards per year so this is a long-standing problem.

What is the value of that 1200 ac-ft of displaced irrigation water in the Santa Maria Valley aquifer? We can estimate this value in several ways. The TMA study used subcontractors to evaluate the cost (in 1998 $'s) of sluicing the sediments that accumulate in the reservoir downstream or pumping them to disposal sites (TMA, p. 35). These estimates ranged from initial capital costs of $6 million plus annual expenses of $7.5 to $13 million to initial capital costs of $21.5 million with annual operational costs of up to $36.3 million. The County and TMA are now cooperating to implement various schemes to restore some of the lost active conservation reservoir storage.

An alternate estimation of value could look at the 20,000 ac-ft of water supplied from the reservoir to irrigators in the Santa Maria Valley. Assuming high value crops with an incentive for water conservation (drip irrigated strawberries) with Santa Barbara countywide production of 35,520 lbs/acre in 2000 we may consider that this is the most valuable groundwater in the Santa Maria Valley that is used for agriculture. Santa Barbara County's 2010 production yield of $392 million (FOB value) from 7680 acres equates to over $5100./acre/year. Broccoli, in contrast, generated $122.5 million from 26,395 acres or $464/acre in 2010 (S.B. County agricultural production data at: http://www.countyofsb.org/agcomm/default.aspx?id=11562).

Strawberries in the valley are irrigated solely by drip irrigation. As is often the case in California, the urban sector competes with agriculture for water in the valley, generating interest in reducing agricultural water use. Despite the use of drip irrigation, there is still uncertainty about the precise amount of irrigation water needed for strawberry production, including for leaching of salts and crop evapotranspiration (ET), as strawberries are sensitive to salinity and water stress (Hanson & Bendixen, 2004).

Using data from the Hanson & Bendixen study we see that rainfall averages 12 inches in the Santa Maria Valley and that additional water applied to strawberries by drip irrigation averaged[2] 15.58 inches (1.3 feet) during the irrigation season from January 1 to July 15. Over the acreage of strawberries of 7680 acres (in 2010), this would equate to approximately 9970 acre-feet of added water derived from groundwater via Twitchell Reservoir.

If the 20,000 acre-feet of irrigation water stored in the Twitchell Reservoir all went to high value crops like strawberries, the annual value of that water based only on what it can grow would be on the order of $800 million. Because groundwater is shared among all agricultural users and municipal users, with higher values for domestic water supplies and lower values for crops like broccoli, a fair estimate for the total value of the 20,000 acre-feet of high-value Twitchell water released to the Santa Maria Valley annually is approximated by its value to strawberry growers, or $800 million per year.

Thus, the $6 million to $21 million estimated annual costs for removing or even preventing silt accumulations in the reservoir are well-justified expenses to maintain the Cuyama River source of water for the Santa Maria Valley.

CUYAMA VALLEY GROUNDWATER RECHARGE IMPACTS

The main water-bearing deposits in the main Lower Cuyama Valley are the saturated portions of the younger and older alluvium and the Morales Formation. (Hansen, 2011) This is what is administratively termed a sole-source aquifer. This means it is the only source of long-term agricultural water in this region. The U.S. Geological Survey's ongoing Cuyama Valley Water study seeks to define and quantify rates of extraction and recharge of this important and limited water resource.

The last major study of water resources of the Cuyama Valley was that of Singer and Swarzenski in 1970 that followed the work of Upson, et al, 1951. The contemporary US

[2] The authors used flow meters to tabulate applied water delivered to 7 of 13 strawberry drip-tape irrigation plots. This value is the average of those 7 measured plots.

Geological Survey study by Hansen will update the older information. During the last 40 years, groundwater levels in the lower Cuyama alluvium have dropped 200 or more feet and it is clear that use of groundwater in the present fashion is not sustainable. The 1999 University of California Bren School study updated some of the well monitoring figures and concluded that water resources would not last an additional 50 years (Bren School, 2009).

Given that the agricultural water withdrawals in the Cuyama/New Cuyama agricultural area are in serious overdraft with approximately a 30,000 ac-ft per year deficit as estimated in the Bren report, it is clear that streamflow in the lower Cuyama Valley is insufficient to support contemporary water uses. The ongoing US Geological Survey study has monitored wells carefully since about April of 2009 and has provided the two following photographs of the New Cuyama area riverbed as well as groundwater level data. The tabulations of progressively declining water levels and character of the river bed both support a hypothesis that groundwater withdrawals exceed surface water recharge through the riverbed.

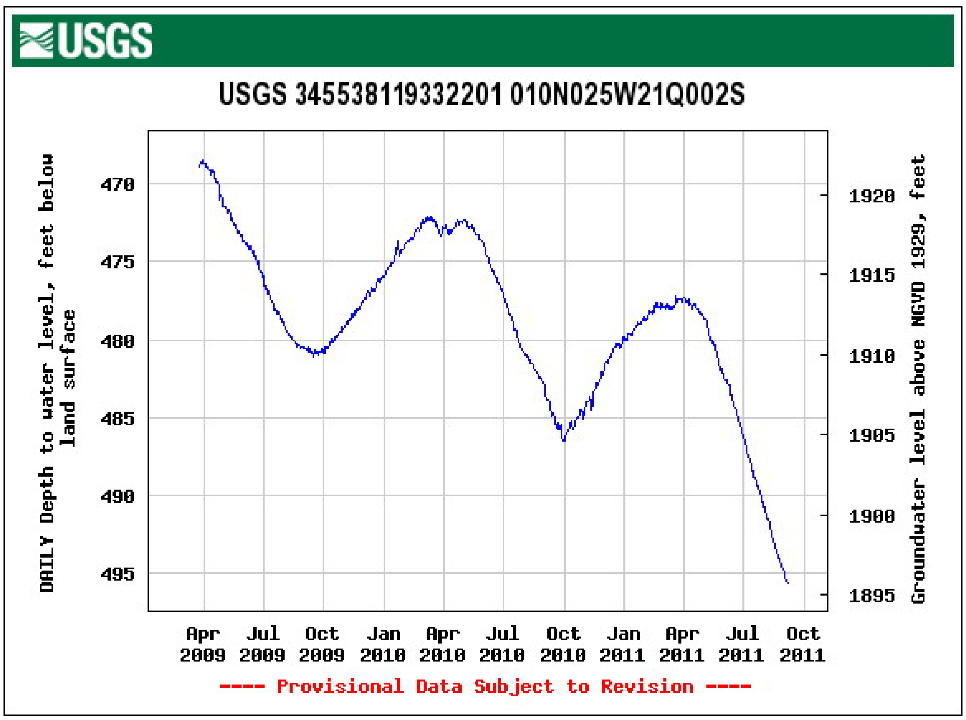

FIG 3 LOG FOR NEW CUYAMA AREA WELL: FROM HANSEN, 2011

Cuyama River sandy and silty streambed in the main zone of Cuyama Valley near Cuyama looking upstream 10/29/2008 R. Hansen USGS Photo from Cuyama Water Study website

Cuyama River desiccation silty clay beds in streambed in the main zone of Cuyama Valley near Cuyama looking downstream 10/29/2008 R. Hansen USGS Cuyama Water Study website.

Silt deposits in the broad streambed of the Lower Cuyama River allow runoff to evaporate before it can all infiltrate. There is no obvious contemporary source for this silt upstream of Cuyama except silt returned to the channel from mined aggregate processing and bank erosion of the Quatal Canyon Formation in the vicinity of the Ventucopa mining channel influences. The upper river in the Ventucopa area above the mine sites is characterized by sand and cobble bed materials, but sand and silt dominate in the lower valley below the mining areas and Santa Barbara Canyon.

Inspection of gauging station records for the Cuyama River at Buckhorn, located at the western end of the Cuyama Valley above the Twitchell Reservoir delta, show that flows in the river are absorbed into the alluvium valley floor and that through-flow into the reservoir is generally restricted to actual rainy days. Flows do not persist for more than two to three days even with substantial rainfall, unlike those in similar watersheds such as the adjacent Sisquoc. Thus, the primary groundwater basin that exists in the Cuyama area does not fill with seasonal runoff and the throughflow that does reach Twitchell Reservoir is characterized by a silt-clay load that temporarily retards local infiltration allowing it to reach the reservoir.

IMPACTS OF IN-STREAM MINING ON SALMONIDS

Contemporary work by Santa Barbara County with the assistance of Stillwater Sciences has developed information that reveals that federally listed Steelhead trout that once spawned in the Sisquoc River watershed and migrated through the Santa Maria River can be reestablished with flow releases from Twitchell Reservoir. http://www.stillwatersci.com/case_studies.php?cid=66

Steelhead habitat in the upper Sisquoc River is not generally accessible today because of groundwater withdrawals in the Santa Maria area. Flows are not deep enough or of long enough duration to allow passage for spawning adults or young-of-the-year often enough to sustain viable populations. Instream flow for passage of these individuals requires slightly deeper lower Santa Maria River attracting flows and longer-duration out-migration flows.

By modifying the bed of the Santa Maria River downstream from the City of Santa Maria and supplying only modest increases in flow to that part of the river with releases from Twitchell Reservoir's conservation storage pool, it is believed that a viable fishery and genetic stock can be retained and maintained (Constantine, 2011). The Los Padres National Forest newsletter explains the strategy: http://lpfw.org/news/1011sisquocsteelhead.htm.

Although the Santa Maria River is dry most of the year, the Sisquoc River is perennial and supports a self-sustaining population of rainbow trout/steelhead. Historically, anadromous steelhead likely migrated upstream from the Pacific Ocean in wet years, during the limited time when flows connected the Sisquoc River to the Pacific Ocean via the Santa Maria River. An ongoing in-stream flow study looks at Twitchell Reservoir releases to provide the frequency, duration, and magnitude of surface flows in the Santa Maria River that would be needed for steelhead to migrate between the Pacific Ocean and habitat in the upper Sisquoc River. The study will result in flow recommendations that more closely support the historical timing, frequency and duration of migration opportunities for anadromous steelhead.

Thus, we conclude that any silt that is released in the Cuyama River that ultimately reduces the conservation storage capacity of the Twitchell Reservoir could not only reduce agricultural water available to the Santa Maria Valley, but also hasten extinction of Santa Maria area steelhead trout. Hundreds of thousands of dollars are currently being spent to evaluate fishery restoration opportunities. Chances to restore these endangered species decrease in proportion to loss of reservoir storage.

HOW MUCH SILT COMES FROM IN-STREAM MINING IN THE CUYAMA RIVER?

There are two primary sources of silt that are released to the river at the existing GPS Mine site that will also be released at the proposed Diamond Rock Mine operations. The obvious source is the fine sand and silt that is separated from the mined aggregate and returned to the river as spoils or by filling of the in-stream excavations and removal by subsequent high flows. Although the ratios of volumes of river bed materials mined and carried to the processing facilities compared to those finer materials returned to the mine-site or elsewhere in the channel are critically important to the economic well-being of the mining ventures, operational estimates are not found in the Conditional Use Permit application materials or EIRs.

Looking at the GPS Ventucopa Rock Plant Final EIR, quoting Sarah Bartling, P.G., (RAM, 2007) we learn that, to be marketable, mined aggregate that might refill excavated pits would need to be 40-70 percent sand and gravel with clay more than 5 percent but less than 30 percent (FEIR, Sect 3.1.2.2.1). It is thus reasonable to assume that these are the same minimum standards for desirable in-stream mined aggregates. Thus, fine sand and silt could comprise up to 55 percent of the raw material carried to the processing plant. Based on observed exposures in the mine pit walls, I estimate that the GPS site in-channel excavations exposed raw material that was about 50 percent directly marketable, and another few percent boulders too large for direct crusher runs.

This means that 40-50 percent of the gross volume of in-channel excavations may become spoils that can be eroded from berms, access ramps and roads, and in-channel waste below the high-water marks of 25-year flood flows. It is reasonable to assume, as do the applicants, that grain size increases somewhat with depth so that 100-year flood flow scouring may leave a discontinuous lag of coarser material at depths of 20 feet or more. It is unreasonable to assume that the requested depth of mining of 90 feet is necessary to reach these possible deposits.

The proposed annual production for each mine (and for the proposed operation of the Diamond Rock Mine for the first 5 years) would be 500,000 tons (or 333,000 cubic yards) and average annual production would be 400,000 tons (or 266,000 cubic yards). Peak Diamond Rock production is stated to be 750,000 tons. If 40 percent of that material were returned to the channel, as it apparently has been in the past, this would equate to a little more than an average of 100,000 cubic yards of sediment per year that can be carried readily downstream to Twitchell Reservoir from each operating in-stream mine. That amount would displace about 62 acre-feet of active storage in the reservoir each year for each operating mine.

But a larger volume of fine sediment associated with the mining appears to come from bank and bed erosion beyond the actual excavation sites. Unlike most gravel-bed rivers the coarse sand and gravel bed material load of the Cuyama River at Ventucopa passes downstream in less than 2 and one-half miles to an area of riverbank that is fine-grained late Tertiary or earliest Quaternary unconsolidated Quatal siltstone. This material is readily eroding on the high left bank of the river and is slumping into the active watercourse (see photo plates). This is a somewhat unusual geologic condition. Most arid-land intermittent rivers flow against riverbanks that they have deposited themselves. The right bank at the mine sites is just such a sandy-gravel deposit. But the left bank is fine-grained and actively eroding just upstream from the proposed Diamond Rock excavation. This site is apparently an actively rising tectonic fold, or anticline. It appears that active GPS mining in the last 40 years has allowed the active channel to shift eastward at the GPS mine pit site as the gradient of the river bed increased. This has allowed or influenced the westward shift of the channel upstream from the GPS pit, and undercut the high west bank of the river, thus entraining much more fine grained sediment than may be introduced by the mine spoils directly. This is not at all what the Diamond Rock EIR states (EIR, 3.1 – p 19).

In part, the channel migration may be due to the locally steepened gradient as the in-stream pits are refilled and channel headcutting moves upstream. Observation of the streambed in the mile-long reach upstream from the GPS pit indicates active bed erosion leaving a lag of coarser cobbles armoring parts of the bed. It is clear that a local left-bank low terrace last occupied before spring of 2002, has now been abandoned with post-2002 flows as the main low-flow flood channel is attracted to the active mining pit. But the new low terrace itself is being eroded at its southern (upstream) limit allowing active erosion of the primary 56-foot high cut-bank of fine-grained sediment (see Plate 2). This deflection of flow toward the excavated pit appears to have not been recognized by the EIR authors who state in Section 3.1.2.2.1:

"Based on the above analyses and considerations, the impact of the low berms surrounding the mine pit on river hydraulics is considered locally a significant but mitigable impact (Class II) due to the potential to locally erode the left bank of the Cuyama River…

There are no bridges, engineered low flow crossings, or engineered bank protection on the Cuyama River in the vicinity upstream or downstream of the project site, and the modeling results indicate that *the hydraulic effects of the berms would not extend to 1,000 feet upstream or downstream of the project site….*

Hydraulic modeling indicates that the berms would not cause any hydraulic impacts 1,000 feet upstream or downstream of the mine pit."

In fact, it may not be the low-flow berms but the pit itself that causes the headcutting and upstream deflection of the high-velocity flow against the easily eroded 50-60 foot-high left bank. And, in fact, channel diversion by attraction of flow to the mine pit extends at least 4000 to 5000 feet upstream (see Fig 2). Because the GPS pit extracted from the active channel and captured active flow during high sediment-transporting events, the gradient of the thalweg (location of high flow and later low-flow channel) is diverted. This influences the channel above the pit as head-cutting increases velocity and fixes the thalweg at the lowest points in the otherwise broad channel. It is for this reason that the US Geological Survey (Langer, 2002, p 25) recommends:

"In general, sand and gravel extraction will have less impacts to the river or stream hydrologic processes the higher up in the landscape the extraction site is located. Extracting sand and gravel from floodplains generally is preferable to removing sand and gravel from stream channels. Extracting sand and gravel from terraces is generally preferable to extracting sand and gravel from floodplains".

Estimation of Silt Load to the Reservoir

We know that about 2 million cubic yards of silt accumulate in the Twitchell Reservoir annually (long-term average ~1,936,000 cubic yards converted from 1200 ac-ft) (TMA 2010). Lateral channel cutting, in part triggered by straightening Highway 166 along the lower Cuyama River and the 1997 - 2009 Cuyama watershed fires have probably contributed the bulk of the sediment in the last few years, some of which may just now reaching the Reservoir. To evaluate these primary sources, we have conducted order-of-magnitude estimations of their potential significance.

The 2009 La Brea Fire burnt about 13, 423 acres of the lower Cuyama watershed, with 1759 acres burnt with a moderate to high severity (TMA, 2010, p.45). The Natural Resource Conservation Service's erosion volumes are estimated in that report to be 4833 cubic yards per square mile within the Twitchell source-area watershed (TMA, *op cit)* which for the moderate to high severity burn area would equate to a modest 13, 283 cubic yards from the Brea fire. Other fires have impacted both the upper (Zaca Fire of 2007) and lower watershed areas (Logan Fire of 1997). Because the Logan fire was followed by the 25-year rainfall and flood flows of 1998, it probably contributed the largest fire-derived sediment load to the reservoir. Appendix 3 of the 2010 TMA report graphically presents the fire history of the watershed from the 1960's to present

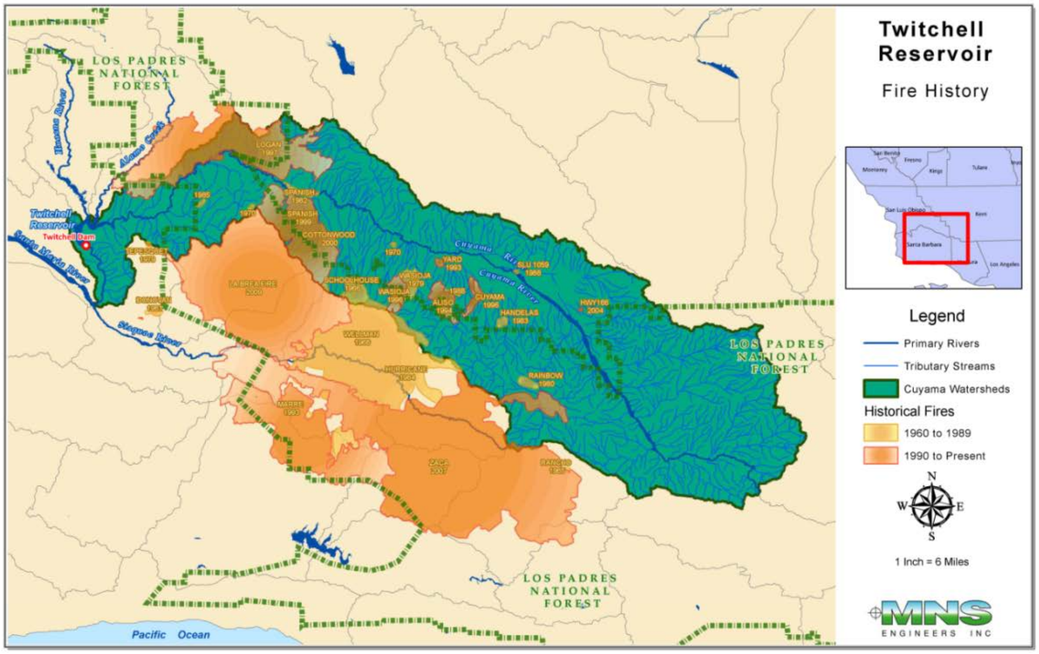

Fig 1 Appendix 3 from the 2010 Twitchell Management Authority report. Scale not accurate for this copy. See original at http://www.ci.santa-maria.ca.us/3119-02.html

Inspection of historic aerial photos (Google Earth Pro, 5-8-1994 through 6-15-2010 approximately annually[3]) reveals that major episodes of downstream sediment accumulation lead to bank cutting as the channel becomes wider. For example, in the New Cuyama area, 1.7 miles N20ºW of the western edge of that townsite, an 8-foot high or higher bank had cut back 250 feet by December of 2006 on the outside of a meander bend. Although that cutting probably primarily occurred during the 1998 floods, we can see that near "Old" Cuyama townsite just upstream, the active channel at one point was about 804 feet wide in May of 2002 and had expanded to 894 feet by January, 2007.

Channel bank cutting is episodic even in the lower Cuyama Valley, as in fact must be sedimentation in the Reservoir. Observations of changes in the southwest riverbank near the mine site indicate continuing contemporary bank cutting and slumping. Comparing ground photographs taken in November, 2011 with those taken as recently as January, 2009[4], we see oversteepened 40-foot high riverbanks slumping into the active Cuyama River channel (Plates 1 & 2 of this report). This site is noted as "tightly folded and faulted Tertiary-aged Quatal Formation overlain by older alluvium"[5] outcropping along the south side of the Cuyama River in the Upper Cuyama River Valley.

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[3] Because the historic boundary of Santa Barbara and San Luis Obispo counties is the Cuyama River, there is much duplication of aerial photography with at least 10 flight-years per county in 40 years.

[4] Plate 2 of Curry, R. R., 2011, Evaluation of proposed mining activities in the Cuyama River alluvial aquifer, p. 7, January 11, 2009 photo. See also USGS 10-29-08 R. Hansen photo of same site from Highway 33. http://ca.water.usgs.gov/projects/cuyama/images/pics/Geology/IMG_0894.JPG

[5] *OpCit*, Hansen, 2011; see also http://geopubs.wr.usgs.gov/open-file/of00-359/apache_expl.txt

PLATE 1 40+ FOOT HIGH ACTIVE CUT BANK 3400 FT UPSTREAM FROM THE GPS MINE PIT, NOV 3, 11

PLATE 2 SAME ANTICLINAL FOLD 1-11-2009 NEAR DIAMOND ROCK SITE - SLUMPED DEBRIS NOW GONE

The distance from the GPS mine site to the Twitchell Reservoir Cuyama delta is about 60 miles and it is about 7 more miles to the Twitchell Dam. If meandering and braiding of the Cuyama channel below Ventucopa contribute sediment, it will be both coarse cobble and fine sand and silt. Coarse sediment in the sand and gravel size range characterizes the upper Cuyama river bed at and above the proposed Diamond Rock mine site. For modeling purposes we may suggest that the lower 40 miles of the Cuyama Valley channel is bounded by fine-grained fine sand and silt riverbank sediments and that channel instability will contribute this material to the reservoir. We know that the west bank of the upper Cuyama near the mine site is also contributing fine grained silt-sized unconsolidated sediment but looking at an order-of-magnitude estimation of the potential contribution on the lower Cuyama only, we estimate the following: A 6-foot high bank on both sides of a 40 mile long channel eroding 0.3 feet (4 inches) per year would contribute a potential 28,160 cubic yards of sediment per year to the Reservoir. To reach a million cubic yards per year (half the long-term accumulation rate), we would have to erode about 10 feet per year of bank sediment at average bank heights of 6 feet, or an average of 5 feet annually from each bank. There is no evidence for this extreme value, no matter how much change Cal-Trans may impose through highway straightening.

Estimating burn areas from the TMA fire map (Fig 1) for the Cuyama watershed of about 15,000 acres for the 1997 Logan fire, 3300 acres for the 2007 Zaca fire and comparing that to the NRCS 13,423 Cuyama watershed acres for the Brea fire, and applying their same sediment yield analyses proportionally to all the fires, we get a rough estimate of 250,000 cubic yards of fire related sediment yielded from about 50 square miles of burn areas if the Brea fire analyses are applied to all the fires areas equally. Because the 1997 Logan fire recovery coincided with the 1998 intense rainstorms, we may hypothetically propose 4 times the yield for that single event which would double the total yield for all fires to give a total estimate of 500,000 cubic yards. That is still much less than the annual accumulation of 2 million cubic yards that is implied by the filling of the reservoir. Fire alone is probably not the primary major source of Twitchell sediment.

So what is the source of the sediment?

As suggested in the 2010 Twitchell Management Report, further work needs to be done to develop a clearer understanding of sediment sources. That report suggested that fire and highway straightening might be the primary sources. Careful field investigations to measure bank heights and historic changes in channel form may demonstrate that there is a “positive feedback effect” that amplifies upstream mining and fire released sediment through progressive widening of the downstream channel to accommodate the new sediment equilibrium. That is, there is a threshold of imposed sediment load that triggers a reequilibration of width-to-depth ratios downstream. I recommend such a study to my colleague Professor Ed Keller at UC Santa Barbara and his graduate students.

It is apparent that fire or highway straightening alone may not be responsible for all of the Twitchell Reservoir sediment. If a conservatively-estimated 100,000 cubic yards of fine-grained sediment is added annually from each active mine, this mining-related sediment may represent as much as 20 percent of the contemporary sediment discharge to the reservoir based on the past GPS mine activities.

Economic Bottom Line Conclusions:

Even if only 10 percent of the accumulating sediment in Twitchell Reservoir is associated with direct and indirect effects of in-stream mining at the proposed Diamond Rock mine site, that equates to a cost to society of 10% of an annual $20 million to $800 million or $2 million to $80 million each year of in stream mining at the GPS and/or Diamond Rock mines. It is very probable that the costs to society exceed the values of aggregate production from in-stream mining in the Cuyama River.

Some References Cited:

Bren School, 2009 Conservation Assessment for the Cuyama Valley: Current Conditions and Planning Scenarios, April 2009 [Cuyama GP Final Project @ http://www2.bren.ucsb.edu/~tnc2/links.html]

Constantine, Candice, 2011, Hydrogeomorphological Study for the Santa Maria River Pilot Channels, Santa Barbara County Flood Control & Water Conservation District, July 2011

Curry, Robert R., 2009 Assessment of analyses of hydrology and sediment transport budget for the Proposed GPS Mine Expansion, Cuyama River, Santa Barbara County, California June 6, 2009 Report to Gary Kaiser, Santa Barbara County Planning and Development

___________, 2011, Evaluation of proposed mining activities in the Cuyama River alluvial aquifer. Report to Gary Kaiser, Santa Barbara Planning and Development, and Jennifer Lee, Save Cuyama Valley, June 2, 2011

Hansen, B. R, and Warren Bendixen, 2004 Drip irrigation evaluated in Santa Maria Valley strawberries CALIFORNIA AGRICULTURE 58(1):48-53. DOI: 10.3733/ca.v058n01p48. January-March 2004.

Hansen, Randy, 2011, Cuyama Valley Project website: http://ca.water.usgs.gov/projects/cuyama/links.html

Kellogg, Karl, S., Scott A. Minor, and Pamela M. Cossette, 2008, Geologic map of the eastern three-quarters of the Cuyama 30′ × 60′ Quadrangle, California, U. S... Geological Survey - Scientific Investigations Map 3002, sheet 1 of 2

Langer, W.H. 2003. A general overview of the technology of in-stream mining of sand

and gravel resources, associated potential environmental impacts, and methods to control potential impacts. US Department of the Interior. OF-02-153.

Santa Barbara County, 2007, Diamond Rock Mining and Reclamation Project http://www.sbcountyplanning.org/projects/03CUP-00037/index.cfm

Santa Barbara County Planning and Development. 2007. Final Environmental Impact Report: Diamond Rock Sand and Gravel Mine Processing Facility. State Clearinghouse No. 2003121049.

__________, 2009, Ventucopa Rock Plant, Ventucopa GPS Mine\2009 Final EIR, 3.1 Hydrology.doc

Singer, J.A. & Swarzenski, W.V. 1970. Pumpage and ground-water storage depletion in Cuyama Valley, California, 1947-66. United States Department of the Interior Geological Survey, Water Resources Division.

Stoecker, J. and M. Stoecker, Community Environmental Council. 2003. Steelhead Migration Barrier Assessment and Recovery Opportunities for the Sisquoc River.

Stoecker, M.W., Stoecker Ecological. 2005. Sisquoc River Steelhead Trout Population Survey, Fall cited in Becker, G.S., K.M. Smetak, and D.A. Asbury. 2010. Southern Steelhead Resources Evaluation: Identifying Promising Locations for Steelhead Restoration in Watersheds South of the Golden Gate. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, CA.

Twitchell Management Authority (TWA), 2010 *Twitchell Project Manual April 23, 2010* .MNS Engineers Inc. in cooperation with the Santa Maria Valley Water Conservation District, 2010. Based on: Santa Barbara County Water Agency and URS Greiner Woodward Clyde, 2000. Twitchell Reservoir Sediment Management Plan.

United States Army Corps of Engineers (USACE), 2008. Design Deficiency Report for the Santa Maria River Levee Project. USACE, Los Angeles District. 102 p.

Upson, J.E. & Worts Jr., J.E. 1951. Ground Water in the Cuyama Valley, California. United States Geological Survey Water-Supply Paper 1110-B.

URS Corporation and Santa Barbara County Planning and Development, 2007, Final Environmental Impact Report, Diamond Rock Sand and Gravel Mine and Processing Facility, Vol 1, EIR, May 2007

Attachment:

May 13, 2008 **RRR**

RAM Environmental
ATTN: Sarah Bartling
2103 20th Street
Bakersfield, CA 93301

RE: Continued and On Going Mining Operations at GPS Mine/Ventucopa Rock Plant
Expansion 03CUP-00000-00059, 03RPP-00000-00003
APN # 149-170-036, 149-210-011, -022

Dear Ms. Bartling:

As I mentioned during our recent meeting, it is common for surface mining operations to continue work while permits for expansion are being processed, even if the work is occurring outside the limits of an earlier permit. This is especially true for the older vested operations. The time that it takes to get through the permit process is largely beyond the control of the mine operator, yet the operator must continue to implement safety measures (i.e., flatten slopes that are too steep) and make the payroll. This type of cooperative approach based on a good faith commitment to diligently pursue the necessary permits is reasonable and necessary.

In general, it has always been the Planning and Development Department's practice to suspend active enforcement efforts while the owner is making "good faith" and reasonable efforts to obtain the necessary permits. Structures that have been built without permits; unpermitted but permittable uses that are occurring are usually allowed to remain/continue onsite until the permit process is exhausted. The decision to require removal of an unpermitted structure or require that a use cease until action is taken on the permit is up to the discretion of the enforcement planner in consultation with the Supervising Planner and Deputy Director based upon the facts of the case and the potential for impacts to the public's health or safety of the environment. In the GPS case, there is no such potential.

If you have any questions regarding this letter, please call me at (805) 934-6259.

Sincerely,

Gary Kaiser, Supervising Planner
Development Review Division