Balance Hydrologics, Inc.®

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# ATTACHMENT G

April 11, 2018

Larry Rice
Executive Director
Redwood Glen
100 Wright Way
Loma Mar, CA 94021
*exec@redwoodglen.com*

**RE: Sediment Management at Point of Diversions on Piney and Hoffman Creeks**

Dear Larry:

You have asked Balance to respond to the County's request for additional information as to the effect of sediment released from Redwood Glen's point of diversion (POD) structures on Hoffman and Piney Creeks during maintenance. Sediment removal described in Redwood Glen's maintenance procedures is summarized as follows:

- At the Hoffman Creek POD, the diversion structure consists of a stainless-steel sink attached to a redwood log across this creek (**Figure 1**). Silt and find sands entrained in the diversion line (hose) extending from the sink to the raw-water tank accumulate in a series of three 55-gallon plastic drums used for settling. Twice annually the drums are drained to the upper bank of Hoffman Creek -- once in mid-spring (March/April) and again following first storm event during the fall (October/November). Each drum is flushed one at a time, with the water and sediment in the drums flowing onto the bank and reintroduced to the creek. The resulting discharge back into the creek from each drum is approximately 55 gallons (7.4 cubic feet) of water containing approximately 0.28 cubic feet or sediment. A total of about 0.85 cubic feet of sediment enters the creek per 'flush', or approximately 1.7 cubic feet per year. Sediment accumulation scooped out of the sink is deposited up slope and does not reenter the stream.

- At Piney Creek POD, the diversion structure consists of a concrete dam across a narrow (4-ft.) bedrock notch, which includes a 2-inch diameter diversion port and bypass port, and a 4-inch diameter sediment sluice port (**Figure 2**). Primarily sand accumulates behind the dam, where there is a maximum volume of approximately 13.5 cubic feet at the level of the bypass port, and about 20 cubic feet at the level of the spillway. Twice annually the sluice port is opened and sediment is flushed downstream -- once in mid-spring (March/April) and again following first storm event during the fall (October/November). When the sluice port is opened, a flush of 13.5 cubic feet (about 100 gallons) of water flows downstream from the port at a rate of about 0.3 cubic feet per second (cfs). The structure is then rinsed with about an additional 50 gallons of water. Approximately 2 cubic feet of sediment is flushed downstream, totaling about 4 cubic feet per year.

To put this amount of sediment in context, sediment yields of about 2,500 to 3,000 tons per square mile are reported for most watersheds on the San Mateo County coast. Thus, maintenance sluicing 2 cubic feet of sand twice a year at the Piney Creek diversion (or 0.1 tons, given 100 lbs per cu. ft. of sediment) and flushing 0.85 cubic feet of sediment twice a year at the Hoffman Creek diversion (or 0.0425 tons) is well within the norms of sediment yield for tributary watersheds of the region. Furthermore, this level of maintenance sluicing is negligible relative to the drainage areas for coastal gages nearby -- Pescadero Creek at the USGS gage near Pescadero, 45.9 square miles; San Gregorio Creek at the USGS gage at San Gregorio, 50.9 square miles; and Gazos Creek above Cabrillo Highway, 11.3 square miles.

As an example, Balance gages streamflow and sediment yield in Gazos Creek, with watershed geology similar to Piney and Hoffman Creeks. In 2002, a below normal rainfall year, bedload yield was 4,800 tons and suspended sediment yield was 5,500 tons (Owens and others, 2003). Though a much larger watershed than Hoffman and Piney Creeks with known landslides and other sediment sources, this yield equates to 93 tons from the 0.10 square mile Piney Creek watershed and 330 tons from the 0.36 square mile Hoffman Creek watershed (**Table 1**). Lower sediment yields per drainage area were found in other streams of the Santa Cruz Mountains, which equate to as little as 11 tons in Piney Creek and 39 tons in Hoffman Creek during 2002. These watersheds also yield significantly more sediment during normal and wet years, and extremely high sediment transport rates following fire.

We conclude that there would not be a hydrologic or geomorphic impact by sluicing and keeping the sediment in the creek as described in your POD maintenance procedures. In addition, if during an extreme event and the Piney Creek diversion dam were to fill with 20 cubic feet of sediment, then the 1 ton of sediment would still be within the regional norms of tributary sediment yields. Though you would likely need to shovel out much of the sediment and deposit it up slope to reactivate the functionality of the diversion structure. In that regard, Redwood Glen may want to also retain the option to capture some of the sediment during maintenance and use on site it as needed.

***Closing***

Please let us know if you have questions or if you need further detail.

Sincerely,

BALANCE HYDROLOGICS, INC.

Mark Woyshner, M.Sc.Eng.
Hydrologist/Hydrogeologist
Senior Consultant and Director

Attachments: 2 figures, 1 table

Cited Reference: Owens, J., Chartrand, C, and Hecht, B., 2003, Geomorphic and Sediment Assessment of the Gazos Creek Watershed, San Mateo and Santa Cruz Counties, California: A Balance Hydrologic report prepared for Coastal Watershed Council, Funded by California Department of Fish and Wildlife, and State Coastal Conservancy, Balance Project Assignment 200022, 41 p

**Table 1. Sediment yield estimates scaled for Pescadero Creek, Hoffman Creek, and Piney Creek based on measured sediment yields in Santa Cruz Mountain streams, San Mateo County, CA**

| Water Year | Bedload Sediment [1] | Suspended Sediment [1] | Bedload + Suspended Sediment [1] | Watershed Area | Percent of Average Annual Streamflow [2] | Bedload Yield | Suspended Sediment Yield | Bedload + Suspended Sediment Yield | Pescadero Cr above Pescadero Marsh (59.7 sq. mile watershed) | | | Hoffman Cr at Pescadero Cr (0.36 sq. mile watershed) | | | Piney Cr at Pescadero Cr (0.10 sq. mile watershed) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Qb (tons)* | *Qss (tons)* | *Qb+Qss (tons)* | *(sq mi)* | | *(tons/sq mi)* | *(tons/sq mi)* | *(tons/sq mi)* | *Qb (tons)* | *Qss (tons)* | *Qb+Qss (tons)* | *Qb (tons)* | *Qss (tons)* | *Qb+Qss (tons)* | *Qb (tons)* | *Qss (tons)* | *Qb+Qss (tons)* |
| **Gazos Creek near Highway 1** | | | | | | | | | | | | | | | | | |
| 2002 | 4,784 | 5,481 | 10,265 | 11.3 | 65% | 423 | 485 | 908 | 25,276 | 28,958 | 54,234 | 154 | 176 | 330 | 43 | 49 | 93 |
| **Corte Madera Creek at Westridge Drive** | | | | | | | | | | | | | | | | | |
| 1998 | 43,251 | 148,912 | 192,163 | 6.0 | 295% | 7,209 | 24,819 | 32,027 | 430,347 | 1,481,674 | 1,912,022 | 2,616 | 9,008 | 11,624 | 735 | 2,532 | 3,268 |
| 1999 | 7,106 | 8,113 | 15,219 | 6.0 | 118% | 1,184 | 1,352 | 2,537 | 70,705 | 80,724 | 151,429 | 430 | 491 | 921 | 121 | 138 | 259 |
| 2000 | 17,007 | 40,174 | 57,181 | 6.0 | 140% | 2,835 | 6,696 | 9,530 | 169,220 | 399,731 | 568,951 | 1,029 | 2,430 | 3,459 | 289 | 683 | 972 |
| 2001 | 391 | 1,011 | 1,402 | 6.0 | 50% | 65 | 169 | 234 | 3,889 | 10,061 | 13,951 | 24 | 61 | 85 | 6.6 | 17 | 24 |
| 2002 | 1,482 | 3,661 | 5,143 | 6.0 | 65% | 247 | 610 | 857 | 14,746 | 36,427 | 51,173 | 90 | 221 | 311 | 25 | 62 | 87 |
| **Los Trancos Creek at Arastradero Road** | | | | | | | | | | | | | | | | | |
| 1998 | 5,418 | 3,398 | 8,816 | 5.27 | 295% | 1,028 | 645 | 1,673 | 61,378 | 38,495 | 99,874 | 373 | 234 | 607 | 105 | 66 | 171 |
| 1999 | 1,135 | 2,639 | 3,774 | 5.27 | 118% | 215 | 501 | 716 | 12,856 | 29,896 | 42,752 | 78 | 182 | 260 | 22 | 51 | 73 |
| 2000 | 1,202 | 754 | 1,956 | 5.27 | 140% | 228 | 143 | 371 | 13,617 | 8,545 | 22,161 | 83 | 52 | 135 | 23 | 15 | 38 |
| 2001 | 200 | 119 | 318 | 5.27 | 50% | 38 | 23 | 60 | 2,263 | 1,344 | 3,607 | 14 | 8.2 | 22 | 3.9 | 2.3 | 6.2 |
| 2002 | 158 | 410 | 568 | 5.27 | 65% | 30 | 78 | 108 | 1,790 | 4,640 | 6,431 | 11 | 28 | 39 | 3.1 | 7.9 | 11 |

Notes:

1. Bedload and suspended measurements by Balance Hydrologics and reported in Owens, J., Chartrand, C, and Hecht, B., 2003, Geomorphic and Sediment Assessment of the Gazos Creek Watershed, San Mateo and Santa Cruz Counties, California: A Balance Hydrologic report prepared for Coastal Watershed Council, Funded by California Department of Fish and Wildlife, and State Coastal Conservancy, Balance Project Assignment 200022, 41 p

2. U.S. Geological Survey gaging station no. 11162500, Pescadero Creek near Pescadero, CA. LOCATION - Lat 37°15'39", long 122°19'40" referenced to North American Datum of 1927, in SW 1/4 sec.05, T.8 S., R.4 W., San Mateo County, CA, Hydrologic Unit 18050006, on left bank, at downstream side of highway bridge, 3.0 mi east of Pescadero, and 5.3 mi upstream from mouth. DRAINAGE AREA - 45.9 $mi^2$. PERIOD OF RECORD - April 1951 to current year



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**Figure 1. Existing diversion structure on Hoffman Creek, Redwood Glen, San Mateo County, CA.** The diversion structure consists of a stainless-steel sink attached to a redwood log across this creek. Sediment entrained in the line extending from the sink to the raw-water tank accumulates in a series of three 55-gallon drums used for settling. Water and sediment is flushed onto the bank duirng maintenance twice a year.


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**Figure 2. Diversion structure on Piney Creek, Redwood Glen, San Mateo County, CA.** The diversion structure consists of a concrete dam across a narrow (4-ft.) bedrock notch, which includes a 2-inch diameter diversion port and bypass port, and a 4-inch diameter sediment sluice port. Twice annually the sluice port is opened and sediment is flushed downstream.