GRAVEL EXTRACTION

This EIR is primarily concerned with the location, number, size, and type of gravel operations to be permitted in the project area. There are various methods of extracting gravel and the method of gravel extraction may vary from site to site and year to year. Three types of gravel removal have been observed in the project area. These are skimming, trenches, and pits.

Extraction Methodology

The first type has been used for many years and is called skimming. This involves skimming the top few feet off the bars leaving a gentle slope towards the channel ranging from 2 to 3 percent. At moderate flows that nearly cover the bed of the river, channel width will increase and water depth will decrease as a result of skimming. The increase in wetted perimeter will cause the river to expend more energy on frictional loss and decrease the efficiency of the river to move sediment at those flows.

During high flows bedload transport and deposition will rework and rebuild the bars. This process is known as replenishment in that the gravel bar will have been replenished and the skimming operation can be repeated the next year. During low-flow years gravel transport and replenishment may not replace the previous year's extraction resulting in a net depletion of the gravel bar. If the depletion continues for several years it can lead to a variety of resource problems.

The second method of gravel removal is trenching. If gravel replenishment is low and bars are skimmed too heavily the low flow channel will become unconfined, excessively shallow, and excessively wide. Channel braiding may result and summer water temperatures will be elevated. Fisheries and other aquatic resource values suffer as a result. Extracting gravel from trenches (trenching) has been used to help alleviate some of these problems in aggraded channels. Trenching is usually done with an excavator on the inside of a meander bend and the low and moderate flow meander patterns are modified. Because of the current extended drought trenches have been used on both the Eel and the Mad River during recent years. Examples of trenches can be seen on the Eel at sites three and four.

Trenching can have significant effects on a river system. As streamflow increases the river may abandon the old channel and occupy the trench. The channel is thus shortened and the gradient steepened resulting in an increase in local stream power. As the water level recedes the old low-flow channel may be completely abandoned, resulting in a loss of benthic invertebrates. Trenches also become "bedload sinks" which limit the downstream migration of bedload until high flows rework and refill the trenches. Trenches with steep side

slopes are hazardous in that they can result in cia. During the past three years this method of extraction has been used to remove very large amounts of gravel per year. The trenches were located on the inside of bends, away from the bank towards the bed of the river.

Freshly constructed trenches have nearly vertical walls. During the summer of 1991 a horse and a child were trapped in a trench in the project area. The horse drowned while the child was rescued. Operators can employ practices that can reduce the risk of accidental drowning. During the summer of 1991 the Arcata Readimix Mad River trenching operation used the following safety precautions. As the gravel pile adjacent to the trench was removed a front end loader would slough off the vertical trench wall and create an angled bank in order to make it easier to exit the water. If a long stock pile of gravel existed adjacent to a new section of trench at the end of a work day a front end loader would cut a path through the pile and slough off the vertical wall at several points.

A third method of gravel removal could be considered pit mining. In these operations gravel is removed from a fairly concentrated area resulting in a depression in the gravel bar. Pits may be deep or shallow. Pits must be carefully planned and located so as to minimize the risk of capturing the river during high flows or entrapping fish while water recedes. Pits containing water and having steep side slopes can be hazardous in that they can result in cia. The Department of Fish and Game generally discourages the use of pits. However, pits can be located on some bars with minimum risk. When carefully designed and located, pits can occasionally be used to establish temporary favorable wetland habitat.

There are other potential methods of obtaining gravel. Temporary or semi-permanent deep holes can be created in some channels. Suction dredges and drag lines have been used in some regions. Gravel can also be found in some seasonally dry intermittent streams.

Gravel is sometimes extracted from old meander scars and elsewhere on high terraces. These operations can result in rather permanent changes in land use (such as from an agricultural field to an open pit mine) and should be carefully considered before implementation, particularly if suitable alternate sources are available.

Resource and trustee agencies desire gravel operators to use best management practices which will result in one well confined low-flow channel instead of four or five separate channels in a braided section. Site specific skimming and trenching operations and a limited use of pits are believed to

be a proper strategy in the project area at this time. When more suitable alternatives are proven they can be adopted.

History of Gravel Extraction from the Project Area.
The quantity of gravel extracted from the project area over time is unavailable. However, a review of historical photographs gives some insight into the extent of these operations.

1911-1915:
Gravel has been extracted from this stretch of the Eel River since about 1911 when the bridge at Fernbridge was constructed. Many early roads began to be surfaced with gravel around 1915. The gravel was also used for a variety of small single-family residences and some commercial businesses when the design called for concrete.

1927:
Some minor gravel extraction activity is evident in the 1927 oblique aerial Photo at Sites No. 1 and No. 2. At that time, the low flow channel existed along the east side of the river particularly along Site No. 2.

1938:
Looking at the set of December 1938 aerial photos, it was determined that no evidence of gravel extraction shows at Sites No. 1 and No. 2. The channel is on the east side of the river in these photographs. The riparian vegetation along Site No. 2 (Fernbridge Bar) appears to be about 50 feet wide. Upstream of the gravel processing area is a hayfield or some other type of cultivation.

The December 1938 aerial photos also show no gravel extraction from Site No. 4 through Site No. 9. The large flood of December 1937 may have caused considerable erosion along the east bank of the river because in the aerial photos show very little if any riparian vegetation remained.

1940:
By December 13, 1940, a bar formed off Site No. 2 and the channel appears to be moving to the center of the river bed at that area. There is no evidence of gravel extraction on this aerial photo probably because of the season. A large island has formed off Sites No. 3 and No. 4 and the low flow channel is in the middle of the river bed and also along the westerly side. No riparian vegetation exists along Site No. 6 whereas a small fringe exists along the east side along Sites No. 7 and No. 8. Very little riparian corridor vegetation occurs on the west side of the river bed from the mouth of the Van Duzen River downstream to Site No. 3.

At Sites No. 10 and No. 11 on the Van Duzen River there is no evidence of gravel extraction in the December 13, 1940 aerial photograph.

1941:
In a November 6, 1941 aerial photograph there is evidence of gravel extraction near Site No. 1 at Singley Bar. Singley Bar is located about one-half mile below Fernbridge and is designated on USGS Map No. 5 of the Arcata Readimix site near the beginning of this report. There is also evidence of extraction at the Fernbridge Bar (Site No. 2). Beyond that, upstream to the mouth of the Van Duzen River there is no evidence of gravel extraction on the 1941 aerial photo.

1948:
In a July 18, 1948 oblique aerial photo, gravel extraction activity is very much in evidence at Singley Bar. Scrap marks occur along the east side of the river bed to within 300 feet of Fernbridge. In an aerial taken a month earlier on June 22, 1948, some activity is observed at Singley Bar, but not as intensive as it was in July.

No gravel extraction can be observed in the June 22, 1948 aerial from Fernbridge up to the mouth of the Van Duzen River.

Small access roads to the bed of the river appear in the 1948 aerials at Sites No. 3, No. 4, No. 6 and south of No. 9 where a road leaves Highway 101 and runs to the mouth of the Van Duzen River and across the Eel River.

1952:
A series of oblique aerial photo taken November 25, 1952 by Freeman Art Studio for the Eureka Chamber of Commerce indicate significant erosion at Site No. 6 owned by Elbert Land. These photographs, of course, do not indicate any gravel extraction because there appears to have been a flood just before the photos were taken.

1954:
Aerials taken July 21, 1954 indicate activity at the Singley Bar on the opposite side from Site No. 1. No activity is observed at Sites No. 2, No. 3, No. 4, No. 5, No. 6, No. 7, No. 8 and No. 9. The low flow channel is along the east bank at Site No. 2 and along the west bank at Sites No. 3 and No. 4, and then it moves back to the east side at Site No. 5. It is along the east side at Sites No. 6 and No. 7, and there appears to be a river crossing at Site No. 7 extending East Ferry Road across to connect with Drake Hill Road. In general, there is very little riparian edge along the easterly bank for the whole project area in July 1954.

1955:
Photos taken just after the 1955 flood show that the bank eroded to a maximum width of 800 feet along a one mile stretch between Sites No. 6 and No. 7 along the east side.

1958:
In aerials taken August 12, 1958, there was a very extensive gravel removal operation at Singley Bar. This was in response to the construction of a new section of Highway 101 freeway nearby. No extraction appears to be taking place at Site No. 2. Some extraction is evidenced at Site No. 3. No extraction is occurring at Site No. 4. The rest of the sites were not covered in the 1958 flight.

1962:
In an aerial photo dated August 22, 1962, there was lots of gravel extraction occurring on Singley Bar near Site No. 1, and no extraction or very little at Site No. 2. There may be evidence indicated for some minor extraction in the neighborhood of 5,000 cubic yards on the east side of the river at Site No. 2 accessible from the west side of Fernbridge. An access road and batch plant were present at Site No. 3.

A large gravel stockpile and extraction activity are indicated at Site No. 5 operated probably by Mercer-Fraser Company. An access to the river bar is indicated at Site No. 6. Minor extraction is indicated off of East Ferry Road along the west bank area opposite Drake Hill Road near Site No. 7.

1963:
Aerial photos taken August 15, 1963 of Sites No. 10 and No. 11 indicate no gravel extraction activity. Riparian vegetation has not developed to any great degree at Site No. 10, nor at Site No. 11.

Aerial photos dated August 14, 1963 show no gravel extraction activity at Sites No. 7, No. 8 and No. 9. Gravel or dirt access roads are indicated off the east end of East Ferry Road and off the west end of Drake Hill Road. At Sites No. 8 and No. 9 the Sandy Prairie Levee appears to be relatively completed.

1965:
Photos taken January 13, 1965 soon after the 1964 flood show that all of the Sites (No. 1 through No. 9) were inundated. Very little riparian corridor remained at Sites No. 1 and No. 2. Sites No. 3 and No. 4 had considerable amount of riparian vegetation remaining. Some of the gravel stockpiles are observed at Site No. 5. No riparian vegetation exists from Site No. 6 to a point upstream of Site No. 7. At Site No. 9 the river got behind the Sandy Prairie Levee.

Sites No. 10 and No. 11 on the Van Duzen River were totally inundated.

1966:
Oblique aerial photographs taken on July 20, 1966 show gravel extraction activity at Singley Bar, Sites No. 3 and No. 5. This activity is confirmed in an aerial photo taken August 10, 1966. The activity at Singley Bar consists of some type of extraction method that left long linear ponds.

The County bar at Worswick (Site No. 2) shows a minor degree of activity in these August 10, 1966 photos.

The operator of Site No. 3 appears to have an extensive gravel extraction operation underway by August 10, 1966.

Site No. 5 appears to have a skimming operation covering an area measuring 600 feet by 800 feet, plus a pit dug into the bar about 1,000 feet off of the easterly river bank.

Moving upstream past Sites No. 6, No. 7, No. 8 and No. 9 there is no evidence of activity in photos dated June 14, 1966. Site No. 10 on the Van Duzen River shows evidence of some minor gravel extraction in the aerial photo dated June 12, 1966.

Very little riparian vegetation exists along the river bank at Sites No. 2 and No. 5. No riparian vegetation exists on the river side of the Sandy Prairie Levee from its beginning at Site No. 5 upstream to the area near Site No. 8. A small amount of material appears to have been removed from the bed on the river side of the levee about 1,000 feet downstream of Site No. 8.

There is no riparian vegetation on the north bank of the river from a point approximately 1,700 feet downstream of Fernbridge to a point 1,500 feet upstream of Fernbridge. The channel of the river is flowing along the north bank at Fernbridge.

1968:
Photographs taken October 7, 1968 show extensive gravel extraction at Site No. 5. The operation consists of skimming, stockpiling on the bar, and some shallow pits. The processing yard with stockpiles and crushers is located up on the river bank at its present site.

A very minor gravel extraction operation is indicated in these photos at Site No. 6 and appears to be related to the lumber mill operation located on the triangular piece of land between Sandy Prairie Road and the levee.

The aerials of October 7, 1968 only cover Sites No. 4 through No. 7. However, an aerial photo dated November 26, 1968 following high water shows clear evidence that there was gravel extraction activity at Site No. 3. The river had braided itself between Sites No. 3 and No. 5 into four channels and indicates some active erosion along the western bank of the river.

1970:
Aerial photos taken on January 28, 1970 show the river at a high stage. All of the gravel bars are covered with the exception of some portions of the braided section between Sites No. 3 and No. 5. Many low areas in the delta west of this region are full of water. The mouth of the Eel River is about 2,500 feet in width. Remains of stockpiles and activity can be seen at Singley Bar, Sites No. 3 and No. 5.

In an aerial photo dated September 10, 1970 of Site No. 11 there is no activity indicated.

1972:
In the July 15, 1972 aerial photo there is activity at Site No. 3 in the form of pit mining and a summer bridge over the one channel of the river. A front-end loader is in use in an area very close to the south end of the County property at Worswick. Site No. 5 is active with a skimming operation occurring along with the construction of a summer bridge. Minor activity is occurring off the east end of East Ferry Road at Site No. 7. There is no activity at Site No. 8.

Site No. 9 on July 15, 1972 was very active with a pit type operation, stockpiles, crusher and processing belts all located on the bed of the river. A large stockpile was located between the levee and the processing yard.

1974:
Aerial photos taken January 16 and 17, 1974 show the Eel River in full flood flow. Sites No. 10 and No. 11 were completely inundated. A few months later photos taken on March 8, 1974 show activity at Sites No. 3 and No. 5 up on the river bank only. Three weeks later a photo taken March 30, 1974 shows the Eel River in full flood. The water was still high as shown in a photo dated April 3, 1974.

An aerial photo taken September 8, 1974 shows all 11 sites. At Site No. 1 there is some minor activity in the form of small stockpiles on the bed of the river at the end of Sage Road.

At Site No. 2 there is a large skimming operation covering an area of 13.7 acres of the bar. This would indicate a

considerable amount of gravel was removed during the summer season of 1974.

Site No. 3 operators are active with some type of pit mining on the bar.

At Site No. 5 it appears skimming was done down to the water level on the west end of the summer bridge.

At Site No. 7 there is evidence of a small pit remaining off the east end of East Ferry Road.

At Site No. 8 there is a pit measuring 200 feet by 300 feet that has been mined. No processing area exists yet at Site No. 8.

At Site No. 9 12.85 acres have been skimmed and the entire processing operation is occurring on the river bed. There is also a large stockpile beyond the levee out of the floodway of the river.

There is no activity at Sites No. 10 and No. 11. However, at Site No. 11 there is a dike that has been constructed across the river channel. By February 7, 1976, the dike appears to have been totally breached and partially removed by the flow of the river.

Also, Sites No. 3 and No. 5 were continuing to be active as indicated in photos taken October 10, 1974.

The photo dated November 21, 1974 shows the Eel River in flood flow. It would appear that 1974 was a year that the Eel River would have moved large quantities of sand and cobbles along the bed of the river considering there were high flows on January 16 and 17, March 30 through April 3, and again on November 21, of that year.

1975-1977:
March 18, 1975 photos show the Eel River again in flood.

Site No. 9 must have been active during the 1975 season as evidenced by extensive skimming marks left on the bed as seen in the aerial taken February 7, 1976. Also, large stockpiles were contained in their yard outside of the levee. 1976 was a drought year and therefore the river was actually quite low in February. Photos taken on the same day of the Van Duzen River showed no activity at Site No. 11.

The photo dated May 13, 1977 shows activity in the yard at Site No. 5, but nothing occurring on the river bed. The same thing can be said for the site regarding February 7, 1976.

The photo of August 30, 1977 shows active gravel extraction occurring at Sites No. 2 and No. 3 and nothing occurring at Site No. 10.

1978:
In a photo dated January 3, 1978, of Site No. 3, it was noted no activity is occurring on the bed of the river. In the same year in a photo dated May 5, 1978 Site No. 9 operations are seen to be active on the bed of the river. The Site No. 8 processing area has not yet been constructed.

Three days later in a photo taken May 8, 1978 activity is occurring in the processing yards of Sites No. 3 and No. 5. No action is occurring on the bed of the river. However, another photo with a 1978 date obviously taken later in the year shows extensive activity at Site No. 5 with a summer bridge to get to the river bar. The operation appears to be removal of gravel from a pit area.

1980:
On aerial photos dated March 7, 1980 it was noted that Site No. 5 processing was occurring, but there was no activity on the bed of the river. At Site No. 2 due to the high flow no activity was on the bed and there was a stockpile on the terrace area near the processing plant.

No activity is observed at Site No. 11 in an aerial taken March 28, 1980.

The Eel River was in a fairly high flow on April 10, 1980. On these aerial photos it is noted that no activity was occurring on the bed of the river at Sites No. 5, No. 8 and No. 9. It is noted that Site No. 8 processing area has been constructed. This is the first documented evidence of the existence of the processing yard at Site No. 8.

Photos dated October 28, 1980 show activity on the bed at Sites No. 2, No. 3 and No. 5.

1981:
By May 31, 1981 it is noted on the photo that Site No. 3 is active as are Sites No. 8 and No. 9. Site No. 5 was not active on the bed at this time. Also, no activity was occurring off the east end of East Ferry Road.

Aerial photos dated June 15, 1981 show a summer bridge and an excavated pit opposite Site No. 3. Small remaining pits are in evidence of the east end of East Ferry Road. The Site No. 8 processing yard is observed on the photo. At Site No. 11 on the Van Duzen River there is a summer bridge, a short dike, and evidence of skimming.

1982:
In the photo dated August 31, 1982 of Sites No. 10 and No. 11 there is no activity noted.

The December 28, 1982 photo indicates a high flow in the Eel River. No activity is occurring on the bed of the river at Site No. 5.

1983:
The photo dated January 31, 1983 of the Van Duzen River shows no activity at Sites No. 10 and No. 11.

In the photo dated March 15, 1983 of Site No. 5 there are many large stockpiles, a batch plant and other equipment. The river flow is high so no activity occurs in the bed.

By July of the same year an aerial dated July 3, 1983 showed no activity on Sites No. 1 through No. 7. Sites No. 8, No. 9, No. 10 and No. 11 were not included in the aerial photo.

1987:
On March 17, 1987 an aerial was taken of Site No. 3. There is an active excavation measuring 300 feet by 600 feet on the river bed accessible via a summer bridge. No activity is occurring at Site No. 2. By June 17, 1987 there is still no activity at Site No. 2. Site No. 3 has continued with the excavation of an area and another summer bridge is under construction.

1988:
In a photo dated March 31, 1988 there is no activity observed at Sites No. 2 and No. 3. A large stockpile is in the processing area of Site No. 3 and at the north end of Site No. 2.

An aerial photograph of Site No. 2 dated May 10, 1988 shows a skimming operation occurring perpendicular to the flow of the river on the bar. There is a large stockpile of material at the north end of the processing area.

In aerial photos dated July 15, 1988 there is very little evidence of any activity at any of the 11 sites. The only exception was Site No. 3 which showed a small excavated pit.

1989:
On April 17, 1989 the aerial photos show that Site No. 2 has a large stockpile at the north end and the south end, but is not showing any activity on the bed of the Eel River. Site No. 3 has a large stockpile, settling ponds, and equipment on the terrace. There is no activity on the Eel River bed. It should be noted here that seven acres of riparian woodland

along 2,000 feet of the bank eroded off the Hackett Ranch (March 8-11, 1989). The riparian woodland was 125 feet to 190 feet wide. In the same flight of aerials it was noted that some activity is occurring at Site No. 11 on the Van Duzen operated by Tom Bess. On aerial photos dated August 25, 1989 it was noted that Sites No. 1 and No. 3 are active on the bed. No activity at Site No. 2, and there may be activity at Sites No. 4 and No. 5 though it is hard to discern for sure on the aerial photo. Sites No. 8 and No. 9 are also active with skimming occurring.

1990:
Aerials taken on May 15, 1990 show no activity on the bed at Sites No. 2 and No. 3.

In a video tape taken from the air on October 10, 1990 by the National Marine Fisheries Service, the following was noted. A small pit was dug on the bar at Site No. 2. A large hole filled with water and sealed off from the low flow channel occurred at Site No. 3. A large stockpile existed in the yard at Site No. 3. At Site No. 4 a pit or shallow borrow site existed on the north end of the island, along with a summer bridge.

At Site No. 5 there were four summer bridges, big stockpiles, and a large excavated area west of the flowing channel. At site No. 7 some minor activity can be seen in the form of a small pit. At Site No. 8 there was activity west of the flowing channel. At Site No. 9 there was gravel extraction on the west side of the channel and two summer bridges.

1991:
On a set of aerial photos taken in July 1991 from Fernbridge to the mouth of the Van Duzen, no extraction activity on the bed is observed for Sites No. 1 through No. 9. The only items seen were summer bridges in place for Sites No. 4 and No. 9. Another photo taken March 29, 1991 of the Worswick site shows that there is no activity on the bed at that time.

From aerials taken November 27, 1991 it is noted that Site No. 1 was active on the bed during the season and that small piles of gravel have been removed. Site No. 2 has stockpiles at the north end of the processing yard and some equipment.

At Site No. 3 the remains of a 1,600 foot long trench are observed. There is a stockpile in the processing yard.

At Site No. 4 there is a very large stockpile in the yard and the remains of a trench barely visible in the photograph.

At Site No. 5 there are the remaining approaches of two summer bridges with no flat cars, a very large stockpile, and some evidence of skimming on the west side of the river.

Some minor skimming is indicated off the east end of East Ferry Road. At Site No. 8 one summer bridge has been pulled, a small stockpile is up in the processing yard and there is no clear evidence of the location of where the gravel was extracted.

At Site No. 9 three remaining sets of approaches to summer bridges with flat cars removed are seen. Some scars left over from skimming and very large stockpiles are noted inside the levee.

Volumes and Sites to be Permitted

The gravel requirements of the local region vary annually. Major construction projects such as freeways, bridges, and large buildings cause temporary increases in demand. Beyond the boundaries of Humboldt County there is an insatiable demand for gravel that could quickly deplete our local gravel resources. If local operators attempt to meet the out-of-county demand by extracting the total project volume of 1,480,000 cubic yards every year they will degrade various river resource values such as fishery habitat and bridge structures, particularly during extended drought periods when replenishment is far below normal.

The amount of sand and gravel that can be safely extracted from the river will vary from year to year and by location. However, it is desirable that independent operators have permits to excavate more than they need for their individual operations. It is also desirable that permitted sites be established so available gravel can be extracted upon demand without going through a long permit process. This can give regulatory agencies and the industry some flexibility to select the location where gravel can best be extracted in order to meet the needs of the entire industry while protecting other river resource values. The annual safe yield of sand and gravel may not equal the total of the annual gravel extraction permits and it is logical that operators will not always be able to extract their permitted amounts at each of the sites described in the Program EIR.

A River Management Plan and Monitoring program can help answer the annual questions of how much to extract, where to extract, and what methods should be used. Such a plan should be developed in the near future.