Sand Dune Stabilization
And
Reclamation
In
Southeastern Colorado

Mike Scharp
Parker Ag Services, LLC
4570 Kashmire Drive
Colorado Springs, CO 80920

ABSTRACT

This paper will discuss how and why Enviro-Gro Technologies (EGT) developed a large-scale sand dune reclamation program using New York City biosolids. The biosolids were applied during the winter of 1992 and 1993. The application site is located about 25 miles east of Lamar, CO and is comprised of 258 acres. Reclamation of the site resulted in its stabilization because vegitation was established on the site thus eliminating the encroachment into other areas.

Based upon experience and negotiation with the Colorado Department of Public Health and Environment (CDPH&E) and the United State Environmental Protection Agency (USEPA) an application rate of 30 dry tons per acre was permitted. In addition, 10 dry tons per acre of woodchips were co-applied. The intent was that the excess carbon would bind some of nitrogen on the site and thus limit the amount of nitrogen that would leach from the site.

Although data indicates that alternative application rates of 10 and 20 dry tons per acre of biosolids were applied for demonstration purposes, little data exist regarding these parcels. Therefore, this paper will deal with the main part of the site where 30 dry tons per acre of biosolids was applied.

BACKGROUND

Enviro-Gro Technologies began April 22, 1992 applying New York City biosolids near Lamar, CO. Typically about 150 wet tons of biosolids were land applied on privately owned dry land winter wheat. The average application rate was of 2.0 dry tons per acre. Application sites changed continuously due to the low application rates.

In anticipation of a hard winter EGT started looking for management alternatives to the agriculturally based land application program in the summer of 1992. This was primarily due to the concern of frozen containers during the winter months, which would be in transport from New York City to Southeastern Colorado for about two weeks. The concern was that the removing and applying the biosolids would require much more work that during the summer months which would degrade and damage the permitted farm

application sites that were being used. In addition, there was a concern that moisture would limit application on these sites during the winter months. EGT was concerned with cause compaction problems for farmers.

Based upon inquires from local farmers, the local soil conservation service and other reclamation projects that EGT were operating, it was determined that a large-scale sand dune reclamation project could and would be undertaken. Such a project would not only address EGT concerns for winter operations, it would reclaim a large piece of ground that was continuing to grow in size. In addition, there was previous research supporting this project, which was done on the US Naval Bombing Range in Boardman, OR during the early 1970's that demonstrated on a research level that such a project could be done.

SITE HISTORY

The application site is located 25 miles east of Lamar, CO along Colorado State Highway 50. It is about 2 miles south of the Arkansas River. The CDPH&E BMP number is 616 and is located in portions of sections 20 and 21, Township 23 South, Range 43 West. The site is part of a larger geographic feature in the area that is over five miles wide in places and stretches almost the entire length of Arkansas River once it reaches the eastern plains at Pueblo, CO.

This exact site, from the information that was told to us, was originally a 30-acre irrigated farm in the early 1900's. However, as the Dust Bowl Era of the 20's and 30's enveloped the Great Plains, the site was no longer farmed.

Wind blown sand from the area continuously increased the size of the site. The moving sand would actually cut the existing vegitation in the surrounding sandy soil and deposit more sand as the "field" encroached on the land to the south. By 1992 the original 30-acre field had grown to encompass almost 300 acres. Eventually, 258 acres was defined as the application area.

When discussions began with the rancher who currently owned the site; it was still part of a larger pasture. However, there was no vegitation at all on the site except a handful of Yucca bushes. The remaining area looked like any large beach area at the ocean and was completely devoid of vegitation.

BIOSOLIDS QUALITY

This project was developed, implemented and biosolids applied prior to the implementation of 40 CFR 503. However, all biosolids that were applied did meet all of these standards. This was possible due to the strong presence in the project of the USEPA.

The biosolids applied were anaerobically digested in New York City. The three treatment plants of the fourteen that did not produce PSRP biosolids were not permitted for application in Colorado. In addition all biosolids meet 38% volatile solids reduction as required for the vector attraction reduction standards. The specific lab data on the biosolids is not available. However, an average biosolids test for the biosolids is as follows:

Biosolids Quality Summary

Parameter	**TKN**	**NH4**	**As**	**Cd**	**Cr**	**Cu**	**Pb**	**Hg**	**Mo**	**Ni**	**Se**	**Zn**
Units	**%**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
NYC	4.54	1.37	<1.9	11.9	183	852	213	<1.6	<2.3	41	<1.8	1188
Table 1			75	85		4300	840	57	75	420	100	7500
Table 3			41	39		1500	300	17		420	100	2800
Woodchips	<. 05	<.003	<1.7	1.8	<3.3	<4.14	<3.3	<.8	<2.2	<3.3	<1.4	19

The average percent total solids of the biosolids are 25%. A copy of the average woodchip analysis is also included to demonstrate that they added little to the site except carbon.

APPLICATION RATES

It was determined that since the site was completely devoid of any organic matter that a 30 dry ton per acre rate would be used for the biosolids. The total amount of nitrogen applied to the site was about 2,700 lbs. per acre. However, due to volatilization it was determined that most of the ammonia would be lost through application and weather prior to incorporation into the soil. Therefore, only about 1,900 lbs per acre of total nitrogen was applied.

At the same time, as an experimental idea, about 10 wet tons per acre of wood mulch was added to the application in order to increase the carbon to nitrogen ratio thereby potentially reducing the potential for off-site nitrate leaching. . The intent was to change to total carbon to nitrogen ratio to about 20:1. In addition, it was thought that the wood would add to the soil structure of the site and add in the reestablishment of vegitation

SOIL AND WATER TESTING

The site was almost completely void of nutrients prior to biosolids application. Below is a chart comparing the soil test collected prior to biosolids application, shortly thereafter and a sample collected eight years after biosolids application.

Soil Tests Summaries

Parameter	Organic Matter	P1	P2	K	Mg	Ca	Na	Ph	CEC	No3	Soil Texture
	%	ppm	ppm	ppm	ppm	ppm	ppm	SU	Meq/100g	ppm	
EGT – 6/23/92	.1	.6	34	111	76	1635	12	8.5	9.2	3	Sand
Agskill – 4/5/93	.6	N/A	N/A	106	103	1050	20	8.1	6.5	1	N/A
Agskill – 10/23/93	.9	N/A	N/A	110	83	1240	13	7.6	7.2	33	N/A
PAS- 6/27/00	1.2	138	148	208	154	1370	N/A	7.7	8.7	5	Sand

The following is a chart indicating the soil nitrate levels in one-foot increments. Data for this was not collected prior to the project but can be assumed to be 0 due to the condition of the site and nitrate levels in the upper one-foot and the fact that the site had been basically unused for decades.

Nitrate Concentrations (ppm)

	0-1’	1-2’	2-3’	3-4’	4-5’	5-6’	6-7’
Prior to Application 6/23/92	3	<3	<3	<3	<3	<3	<3
Agskill - 4/2/93	1	1	2	1	2	2	Not Done
Agskill - 10/21/93	33	33	39	33	36	23	5
PAS – 6/27/00	5	4	4	4	4	3	Not done

Water monitoring data was difficult to find from over the years. A summary of the data found is as follows:

Windmill Site
(1/2 mile from application site reported mg/l)

DATE	TDS	Nitrate	P Total	K	Cd Total	Cu Total	Ni Total	Pb Total	Zn Total	Specific Gravity Umhos/cm	Fecal Coliform
4/12/93	502	.02	.006	5.2	.001	.109	.028	.026	4.8	940	ND
8/12/93	502	.07	<.01	.006	<.001	.007	.027	<.001	.251	988	Not Found
9/20/93	614	.1	UD	6	Not Done	<.01	Not Done	Not Done	Not Done	960	Not Done
10/28/93	670	.15	Not Done	6	Not Done	Not Done	Not Done	Not Done	Not Done	1050	Not Done
1/20/94	No water Available										
6/20/00	Not Done	Un-detectable	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done

RESEEDING

The site had a seed mixture applied using a seed drill as prescribed by the local Soil Conservation District. The site was reseeded the spring of 1993 after application was complete. The mixture was as follows:

Seed Mixture	Lbs./Acre
Prairie Sand Reed	.35
Side Oats	.45
Sand Bluestem	.30
Indian Grass	.75
Native Little Blue Stem	.70
Indian Rice grass	.30
Sand drop	.10
Sand Love grass	.30
Blackwell Switch grass	1.00

OPERATIONS

Two staging areas were constructed at the application site. These staging areas were constructed by pushing soil up into berms. The areas were three sided so that trucks could unload in the area. These were located outside of the sand dune area but within the permitted area so that when the operations were complete they could be reclaimed with biosolids.

Woodchips were delivered into the staging area using live bottom floors. The 100 cubic yards of wood chips was unloaded on to the ground. Instead of mixing the biosolids and wood chips prior to application, they were independently applied and tilled into the site. The wood chips would be loaded into a Knight spreader and applied evenly over the site.

The biosolids arrived in sealed watertight containers by rail from New York City with 20 tons of biosolids each. The winter was extremely cold in the Northeast. Consequently, a number of containers had to be scrapped out using a Gradall with a telescoping arm in order to remove the frozen biosolids from the sides of the container. The biosolids were then broken up by driving heavy equipment over it until it could be applied with the Knight spreaders. Frozen chunks that could not fit into the loader were left in a pile to thaw over time.

Once the mixture was applied, it was tilled into the soil when weather conditions allowed.

ISSUES OF CONCERN

There were many issues that were raised during this project by concerned individuals. However, it is important to note that when farmers have small "blowouts" on their own farms one method of stabilization is to either apply large amounts of feedlot manure when available on that specific site. The other is to use old discarded tires spread over the site in hopes of stopping the erosion.

The first issue developed prior to application beginning. The school superintendent at Granada, about two miles from the site was receiving odor complaints about the program. Although this was not possible because operations were not beginning until Thanksgiving and it was early August it was investigated jointly by CDPH&E and EGT.

Upon visiting the superintendent it was determined that the school itself was generating the odor complaints because they had applied fresh feedlot manure to the football field in hopes of improving the turf. However, the superintendent freely admitted that it was easier to let us take the blame than for him. So he had no interest in dispelling the perception that the biosolids application would not cause an odor problem in town.

Another minor problem developed when individuals claimed that the site was an old Indian summer camp and that they hunted arrowheads there. Their concern, although they new the value of stabilizing the sand dune, was the fact they were losing a prime arrowhead hunting site.

The main generator of concerns was the County retained agronomist who was an inspector on the project. He was deeply concerned about nitrates leaching from the site. Although, the County Commissioners understood that the long-term environmental improvement of the site outweighed the short-term potential of some nitrates leaching into the groundwater the local agronomist continued to raise concerns over the nitrates.

CONCLUSIONS & RESULTS

The final application rate for the site was 32 dry tons per acre. There were other rates tested on the site but the primary rate was the 30 dry tons per acre with about 10 tons of woodchips applied.

It has been determined by review of this project and other available data that the 30 dry tons per acre is the appropriate application rate. It was determined that the woodchips did little for the site. A new permit is currently being issued by the CDPH&E for another sand dune stabilization project. No woodchips will be required.

About five months after seeding a report from the local inspector reported that there were many bare spots with the following plants being present:

Yucca	Sunflower	Buffalobur
Kochia	Russian thistle	Coklebur
Crabgrass	Pigweed	Buffalo gourd
Tall fescue	Sand drop seed	Annual bursage
Three Awn	Sand love grass	Sand sagebrush
Wild carrot	spiderwort	

The dominant species was the Russian thistle. The site was visited again during the spring of 2000. Russian thistle is still the dominate species however wild sunflowers are abundant. Meanwhile other grass species are making progress.

According to some of the ranchers the problem could have been the timing of the reseeding. Moisture is a very important issue. The reseeding was done about a week or two after a rain event when the site was fairly dry. It has been suggested that the site was too dry. In order to address this situation, Parker Ag plans to aerial seed the next site after the biosolids have been applied immediately following a moisture event.

This issue of what crops have revegetated the site is one of the problems with the project. The rancher agreed to fence off this area and has not allowed cattle in the site since 1992. However, many people believe the project failed because the land is not actively being pastured. That was not the goal. The goal was to stabilize it and to stop it from growing. That has happened. However, the original goal was not communicated well with the citizens.

As shown by the poor quality of the water data as with the availability of all the lab data on this project, that it is critical to work out a monitoring program prior to the project beginning. Additionally it is useful to take detailed notes and have the same person collect the samples if possible to reduce the potential for error. It is impossible to go back and recreate it after the fact and without baseline data; much of the data collected thereafter is useless.

Based upon the success of this project, the regional health board has approached Parker Ag with an interesting project. There are large sand dune areas located on the southwest edge of Lamar. They are currently encroaching into the town and producing poor air quality due to particulate matter. It is their idea to have Parker Ag stabilize these sand dunes with biosolids in order in to improve the air quality of Lamar.

In summary, the land application of biosolids to stabilize sand dune in Colorado can be done. It has been very successful and is a very good way to reclaim large portions of land from past environment degradation.